Vol. 8, No. 4
February 28, 1983

Energy Research Abstracts

Abstracts 6688-8903

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830. Telephone (615) 576-1303; (FTS) 626-1303.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $6.00, foreign $7.50 per copy; annual cumulative index, domestic $10.00, foreign $12.50 per copy. The annual subscription price is $70.00 for domestic subscribers and $87.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $150.00 for domestic subscribers and $187.50 for foreign subscribers. A single issue costs $6.50 (domestic) or $8.15 (foreign).

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A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB83-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB83-915300.

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Geothermal Energy Technology (GET)

A semimonthly current awareness bulletin devoted to information on the exploration and development of geothermal resources. Available as PB83-914700.

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A semimonthly current awareness bulletin covering all aspects of the nuclear fuel cycle, both front end and back end. Available as PB83-913400.

Nuclear Reactor Safety (NRS)

A semimonthly current awareness bulletin covering the following safety aspects: accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures. Available as PB83-913500.

Radioactive Waste Management (RWM)

A semimonthly current awareness bulletin covering the following management aspects: transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers. Available as PB83-902900.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the Energy Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the Energy Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to catalog official DOE issue-and-policy documents, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $150.00 for domestic subscribers and $187.50 for foreign subscribers. A single issue costs $6.50 (domestic) or $8.15 (foreign). The cumulative indexes will be available in microfiche form only. The microfiche may be purchased from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 and from Engineered Systems, P. O. Box 866, Oak Ridge, Tennessee 37830.

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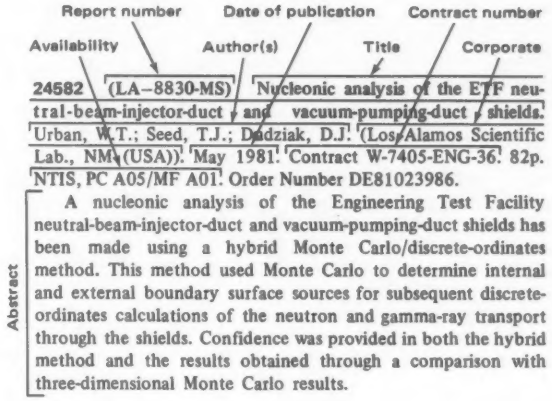
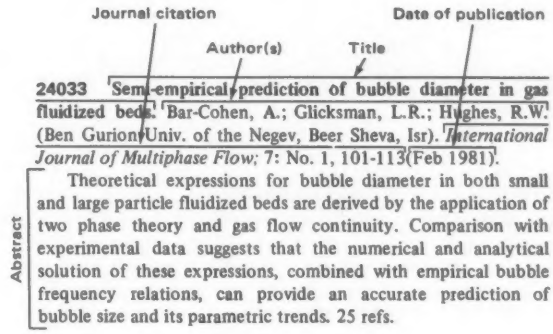
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Contract number
Availability
Author(s)
Title
Corporate
24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.
Abstract
A nucleonic analysis of the Engineering Test Facility neutral-beam-injector-duct and vacuum-pumping-duct shields has been made using a hybrid Monte Carlo/discrete-ordinates method. This method used Monte Carlo to determine internal and external boundary surface sources for subsequent discrete-ordinates calculations of the neutron and gamma-ray transport through the shields. Confidence was provided in both the hybrid method and the results obtained through a comparison with three-dimensional Monte Carlo results.


Journal citation
Date of publication
Author(s)
Title
24033 Semi-empirical prediction of bubble diameter in gas fluidized beds. Bar-Cohen, A.; Glicksman, L.R.; Hughes, R.W. (Ben Gurion Univ. of the Negev, Beer Sheva, Isr). International Journal of Multiphase Flow; 7: No. 1, 101-113 (Feb 1981).
Abstract
Theoretical expressions for bubble diameter in both small and large particle fluidized beds are derived by the application of two phase theory and gas flow continuity. Comparison with experimental data suggests that the numerical and analytical solution of these expressions, combined with empirical bubble frequency relations, can provide an accurate prediction of bubble size and its parametric trends. 25 refs.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. **(Los Alamos Scientific Lab., NM (USA)).** May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Bar-Cohen, A., Semi-empirical prediction of bubble diameter in gas fluidized beds, 7:24033 (J:US)
Dudziak, D.J., *See* Urban, W.T., 6:24582
Glicksman, L.R., *See* Bar-Cohen, A., 7:24033
Hughes, R.W., *See* Bar-Cohen, A., 7:24033
Seed, T.J., *See* Urban, W.T., 6:24582
Urban, W.T., Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

TOKAMAK ETF
Neutral Atom Beam Injection
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)
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• Contract Number Index

DOE technical literature is indexed using contract numbers under which the literature was produced. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36 **Los Alamos National Lab., NM (USA)**
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• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order Number–Report Number Correlation is included for convenience.

LA–
8830-MS 6:24582 NTIS, PC A05/MF A01. Order Number DE81023986, Distribution Category STD-20d

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

6688 Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980). 338p. (CONF-790770—). Institute of Gas Technology, IIT Center, 3424 South State Street, Chicago, IL 60616 $40.00.

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Papers presented at the symposium are presented in this document. Subjects included are: utilization of peat for conversion to other fuel forms, such as gases and liquid fuels; the combustion of peat; peat availability; peat harvesting and mining; peat dewatering; land reclamation and environmental considerations; and national and regional peat development programs. Separate abstracts have been prepared for 22 papers, two of which were imput earlier. (DMC)

0104 Processing

REFER ALSO TO CITATION(S) 6751, 6812, 6812, 6857, 6858, 6859, 6877, 6926, 7236, 7261, 7270, 8031, 8031

6689 (AD-A—114658/8) Government support for synthetic pipeline gas uncertain and needs attention. (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 14 May 1982. 114p. NTIS, PC A06/MF A01.

Some private groups are seeking Government support for U.S. plants based on a 'first-generation' process which has been used abroad for decades. Other groups have been considering a 'second-generation' of advanced processes which have been proven in pilot plants and are now ready for commercial demonstration. Still others look to a third generation of even more advanced processes which are just beginning pilot plant testing. The Government has already spent millions of dollars. GAO saw a need for an independent assessment of the results of this investment to help ensure that future funds would be spent wisely. The Department of Energy (DOE) provided most of the RandD support. Now, however, commercial-scale demonstrations including those for high Btu gasification will have to look to the newly created Synthetic Fuels Corporation for government financial assistance. GAO recommends that the Secretary of Energy do the following: establish a plan to guide future support of high-Btu coal gasification energy research and development; evaluate the importance of the high-Btu second-generation process as a method of using eastern coal, and the prospects for accelerating the processes as commercial scales; and report to the Synthetic Fuels Corporation's Board of Directors on the potential role of second-generation processes in the synthetic fuel program.

6690 (BMFT-FB-T—82-073) Steam gasification using steam-soluted catalysts. Sulimma, A.; van Heek, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750718.

The catalytic effect of alkaline on steam gasification of coal has been known since more than 50 years. Recent research work confirm these results. Thus K_2CO_3 and KOH are supposed to be the most effective catalysts. This work aims to prove a new technically interesting method of charging catalysts on the basis of a solution of the active substances in high pressure steam in a small fluidized bed pilot plant. The trials performed confirmed the applicability of this method of feeding catalysts. Moreover the acceleration of the reaction is dependent on the amount of catalysts given to the coal, whereby it has to exceed a certain limit caused by reactions of the catalysts with the minerals in the coal. A further result is that the catalysts fed with the high pressure steam stay in the fluidized bed up to high degrees of gasification. This effect is advantageous for the allothermic steam gasification of the PBP-project. In this gas generator coal loaded with catalyst migrates through the horizontal gas generator. Thereby the degree of carbon burn off and simultaneously the concentration of the catalyst increase. Thus the reaction rates can be increased by a factor of 10 and more even at low initial catalyst loading.

6691 (BMFT-FB-T—82-107) Hard coal gasification using catalysts dissolved in steam. Reinhardt, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750957.

Since the middle of the seventies, coal gasification and liquefaction have regained economic interest. Chiefly in the United States and in Germany, extensive studies of the underlying chemical reactions and for process development have been performed. For an input of energy from high-temperature reactors in order to reduce coal consumption, a rather low process temperature is desirable. This can be achieved by use of catalyst. Catalyst, as being otherwise added by dry admixing or impregnation, is introduced in this process by dissolving it in the gasifying medium. Poor solubility of the catalytically active salts in steam at pressures below 100 bars has been overcome by a supersaturation technique, the handling of which has been elucidated in detail. Suitability of various salts for the process has been screened. Because of premature termination of the project, the search for optimum concentration and composition of catalyst salt could not be accomplished. For very diluted catalyst concentrations, this process appears to be superior compared to concurrent methods of catalyst addition. Moreover, catalyst feed during the course of the reaction might be another advantage of this process.

6692 (BMFT-FB-T—82-114) Basic engineering of a 10 t/h-prototype plant for the VEW coal conversion process. Weinzierl, K.; Deggim, D.; Poller, J.; Karger, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82751000.

1. Operation under pressure is the new concept of the VEW coal conversion process. It makes necessary a lot of considerations for all devices. The report shows the results of a fully prepared basic engineering for a 10 t/h-prototype plant. 2. The prototype plant consists of the following sections: the gasification unit with coal milling and drying, the coal feeding, the waste heat recovery and gas/char separation, the gas cleaning unit with the gas cooling, the H_2S-removal, the evaporation and sulfur production.

6693 (BMFT-FB-T—82-133) Joint Australia/Federal Republic of Germany feasibility study on the conversion of Australian coals into liquid fuels in Australia. Imhausen, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1982. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE82751004.

1. The IG-hydrogenation process used commercially in Germany up to 1945, has been improved in essential parts until 1979. Pilot plants in Germany are presently under construction or in the start-up phase. 2. Development of a detailed technical concept for the conversion of Australian bituminous coals and/or Australian brown coals into automotive fuels using coal hydrogenation, gasification and Fischer-Tropsch synthesis and to develop the economics of commercial plants. 3. Development of technology, consumption figures and of expenditure/investment for a complete plant produc-

ing about 3 million tons of automotive fuels per year. 4. The results of the study show that standard automotive fuels are produced from bituminous coal using a combination of high-pressure coal hydrogenation and of Fischer-Tropsch synthesis, and from brown coal using high-pressure coal hydrogenation only. 5. Under the assumption that crude oil prices increases 3 per cent more rapid per year than the general inflation, and the raw material cost are staying at a low level, commercial plants shall be built.

6694 (CONF-820818—2) **U-GAS process for production of synthesis gas.** Patel, J.G.; Schora, F.C. (Institute of Gas Technology, Chicago, IL (USA)). 1982. 22p. Institute of Gas Technology, 3424 South State Street, IIT Center, Chicago, IL 60616.

From International coal conversion conference; Pretoria, South Africa (16 Aug 1982).

The Institute of Gas Technology (IGT) has developed an advanced process - the U-GAS process - to produce gas from coal in an efficient, economic, and environmentally acceptable manner. The product gas from the process could be used to produce low-Btu gas, medium-Btu gas, and substitute natural gas for use as fuels or chemical products such as ammonia, methanol, hydrogen, oxo-chemicals, or electricity generated by a combined cycle or a fuel cell. The U-GAS process development program has shown economical handling of large volume throughput with high conversion of coal to gas in an environmentally acceptable manner. A substantive data base has been established to provide scale-up design data and to document process flexibility and gasification suitability for a number of coals, including highly caking bituminous coals. IGT believes the U-GAS technology has wide commercial application and will be suitable for feedstocks ranging from peat to anthracite. The process is now on the way for its first commercial application. The U-GAS process, is the basis for an industrial fuel gas plant to be built by the Memphis Light, Gas & Water Division of the City of Memphis. It is expected to come on-stream in early 1986. Preliminary design is also underway for another plant being considered by VEG Gasinstituut in the Netherlands.

6695 (CONF-8105173—, pp 6p, Paper 7) **Cleaning and desulphurization of gases of pressurized coal gasification plants for application in integrated combined cycles.** Heyn, K. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

A possibility of reducing SO_2 emissions and emissions of dust, NO/sub x/, chlorine and fluorine from coal-fired power stations is offered by the linked operation of coal gasification, coal gas cleaning and a combined gas/steam turbine process. The optimal gas cleaning concept is discussed in connection with the used-gas turbine type, for a plant type in which coal is gasified in a fixed bed under pressure with air and steam and in which is installed a combined cycle with a supercharged boiler. The paper is concerned with the operating experience and the measured emissions of such a plant.

6696 (CONF-8105173—, pp 6p, Paper 26) **Perspectives of the Saarberg coal liquefaction process.** Wuerfel, H. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Research and development work at Gesellschaft fuer Kohleverfluessigung (GfK) on coal liquefaction is based on the IG-Farben liquid phase process which has been proven on industrial scale production plants. The main object of this development programme is: the lowering of the process pressure from 700 bar to 300 bar and below by applying iron-based catalysts, the reduction of hydrogen consumption, improvement of heat economy, application of large size equipment, and production of hydrogen from the hydrogenation residue by pressurized partial oxidation. All these measures improve the economy of the coal liquefaction process. It was established that the process pressure could be reduced to 300 bar by lowering the asphalt content in the slurry oil; further, a high versatility of the process was demonstrated by adjusting the catalysts to the different properties of the coal feed, it was, therefore, considered necessary that these results be backed-up further in large-scale test plants. For this purpose GfK has installed a pilot plant with a capacity of 6 tons of coal per day which was completed the end of 1980. In this plant a new system for preheating the coal slurry will be tested. Processing of the hydrogenation residue will be another priority. Early in 1980 the Saarberg company began a project study for the installation of a complete coal liquefaction complex. The study will also cover environmental aspects. A decision to build the plant could be reached by 1982.

6697 (CONF-8105173—, pp 8p, Paper 29) **Desulphurization of Polish steam coal fines by the methods of fluidization and pyrolysis.** Maslowska-Kusnierz, B.; Zajac, T.; Drys, S.; Firek, A.; Sakalus, E. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In the paper two methods of desulphurizing boiler coal are discussed: the fluidization method consisting of gravitational separation in an aerial medium and a mixed method which is a combination of heat treatment (pyrolysis) and magnetic separation. The results of investigations presented in the paper have proven the efficiency of the proposed methods of desulphurizing coal and thus of reducing the emission of sulfur compounds into the atmosphere.

6698 (CONF-8105173—, pp 11p, Paper 30) **Developments in the application of the Stretford Process for the purification of fuel gases.** Farrington, F.; Wilson, B.M. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The British Gas Corporation's Stretford Process for the selective removal of hydrogen sulphide from gases is described and its current fields of application are listed. The conditions under which its use is particularly advantageous are enumerated and capital and running costs are given as related to the purification of typical fuel gases. Application of the Process to projects dealing with hundreds of tons of sulfur per day have been opened up by developments in sulfur handling and the establishment of reliable and stable supplies of Process reagents. The Stretford Process is a selective, single-stage process which can remove hydrogen sulphide down to the limits of measurement and provide acid specification sulfur. There are no liquid effluents and 2 to 5 percent of the sulfur is produced as commercial grade sodium sulphate. The process involves the circulation of a dilute aqueous solution containing innocuous chemicals at slightly above ambient temperatures and the unit operations involved are essentially simple and straightforward, using conventional equipment. There are no known limits of operating pressure of hydrogen sulphide concentration. There are approximately 100 Stretford plants operating or under construction, covering a wide range of gases. The British Gas Corporation offers the process through its licensees, which include some of the leading world engineering organizations (Appendix I). The process is serviced by a team of chemical engineers and chemists operating in the north-west region of the British Gas Corporation.

6699 (CONF-8105173—, pp 14p, Paper 31) **Desulphurization of unconventional oils (oils from coal and shale, heavy oils/bitumen).** Graeser, U. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The decreasing resources of conventional oil and the need for greater independence and security in the energy supply have initiated widespread activities in order to make heavy oil/bitumen, coal and oil shale available as alternative energy sources with the same or similar characteristics as fuels derived from crude oil. The oils produced from these feedstocks are very different in their qualities compared to conventional crude and always need ordinary upgrading in order to obtain a given target specification for the syncrude. In general, heavy oil/bitumen, coal or oil shale are highly contaminated with sulfur. In all cases however the oil production procedures and the primary upgrading includes a reduction of sulfur to such a level that the requirements for syncrudes are met. For the conversion of heavy oil/bitumen the VEBA Kombi Hydrogenation process is described. This process combines a liquid phase hydrogenation where hydrocracking with suspended one-way catalyst takes place directly with a gasphase hydrogenation. In the gasphase unit, the cracked products are treated on hydrotreat-

ing catalysts in a fixed bed. The production of synfuels from coal includes two desulphurization steps. In the liquefaction step, where a modified Bergius-Pier liquid phase hydrogenation is applied, more than 70 percent of the sulfur is removed. The oil produced from coal contains less than 1000 p.p.m. S and is desulphurized completely in the succeeding upgrading procedures. When retorting oil shale from the Schandelah deposit in the Federal Republic of Germany about 20 percent of the total sulfur is transferred to the shale oil and the retort gas. The shale oil contains 4 percent wt of sulfur. The upgrading procedure which consists mainly in severe hydrotreating includes desulphurization of more than 99 percent.

6700 (CONF-8105173—, pp 10p, Paper 35) **Status and development of coal gasification.** Juentgen, H.; van Heek, K.H. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Gasification is a well-known technique of coal conversion and has been applied world-wide for the production of synthesis gas from coal, for the manufacture of ammonia and hydrocarbons and also for the generation of medium BTU gas. During the 1960s and 1970s intensive research work was devoted in the major industrialized countries to the further development of gasification techniques. The common objective of these developments has been to ensure that when oil and natural gas become scarce, coal can be used as an environmentally acceptable and convenient secondary source of energy as well as to provide feedstock for chemical industries and for the mineral oil industry, especially in the production of synthetic gasoline. The paper deals briefly with the fundamentals of coal gasification. Commercial coal gasification processes and the above-mentioned new developments are described. The processes are discussed with regard to environmental protection. On the whole it can be stated that coal gasification is to a considerable extent a non polluting process with high efficiency and one with a minimum of emissions in terms of the output of energy or products.

6701 (CONF-8105173—, pp 10p, Paper 36) **Elimination of heteroatoms during the hydroliquefaction of coal.** Pregermain, S. 1981. (In French). NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

An analysis of previous work reveals that, generally speaking, heteroatoms (O, N, S) involved in a heterocycle form much more stable compounds than heteroatoms involved in other functions. This stability is even greater when the heterocycle belongs to a polynuclear aggregate. In coals, the proportion of oxygen involved in heterocycles is relatively small. Phenolic functions are, however, relatively stable and resist hydroliquefaction carried out under certain conditions. The proportion of organic sulfur involved in heterocycles is much larger than that of oxygen. Only a part of such sulfur present in large molecules can be eliminated by hydroliquefaction reactions. The fact that nitrogen almost always forms part of heavy or moderately heavy heterocycles makes it very difficult to eliminate. As a result of our work, we can demonstrate that sulfur and nitrogen can be eliminated by raising the temperature of hydroliquefaction of a coal so as to achieve preliminary cracking of the heaviest products. The lighter products thus obtained easily lose their sulfur or nitrogen, whereas the heavy products retain them in virtually the initial concentration.

6702 (CONF-8105173—, pp 11p, Paper 38) **Potentials of reducing the sulphur contents of hard coal.** Leininger, D.; Monostory, F.P. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Hard coal is one of the most important energy sources in the Federal Republic of Germany. Sulfur as a quality feature of hard coal is gaining in importance because of its effect cost of further coal treatment and on account of the legally imposed lowering of SO_2 emissions. Activities for hard coal desulphurization within the preparation cycle have been carried on for over 14 years as joint efforts of the Steinkohlenbergbauverein and Ruhrkohle AG Essen. As a result of these activities partial desulphurization has been achieved whereby sulphide and mineral pyrite exclusively are removed from the coal. The degree of comminution and the related degree of pyrite separation required for the dissociation of pyrite are determined by such characteristics as density distribution or degree of intergrowth. Aside from raw material investigations carried out in the Ruhr area, the emphasis has been on the investigation of separating methods, reactors and process combinations or runs. For this purpose two pyrite plants have been erected and put into operation. The findings from them were used for the design of new coal washeries. Calculations have shown that cost expenditures for saleable coal can soar along with progressive reduction of sulfur from DM/t 9 to as much as DM/t 66 due to higher investments in machinery, higher yield losses and the indispensable thermal drying.

6703 (CONF-8105173—, pp 14p, Paper 63) **Preparation of low-sulphur synthetic fuels from coal in the United States.** Janes, T.K.; Denny, D.A. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Since the OPEC embargo of 1973, the United States Government has taken steps to develop, improve and promote the use of processes for producing gaseous and liquid fuels from coal and oil shale. The high sulfur content of many domestic coals requires the removal of sulfur during the production of the synthetic liquid or gaseous fuels. The United States Environmental Protection Agency (EPA) initiated programmes to assess and limit the adverse environmental impacts that may be caused by large-scale conversion of coal to gaseous or liquid fuel. Data for the assessments are being obtained from design studies and pilot-plant operations in the United States and from monitoring of waste streams from commercial-scale coal conversion plants in other countries. In the near future EPA will issue Pollution Control Guidance Documents that contain information on effectiveness and costs of technologies for controlling the release of pollutants from various coal conversion technologies. Background studies for these documents indicate that gasification and liquefaction plants can be expected to remove from 96 to 99.5 percent of the total sulfur content of coal. For indirect liquefaction plants based on Lurgi gasification, the cost of plant pollution control is expected to range from 13 to 20 percent of the total capital investment and from 12 to 21 percent of the annual operating expense. EPA plans to continue and expand its field measurement projects to provide a more complete data base on pollutant discharges to all media, and to evaluate techniques for controlling such discharges. EPA plans to assess the potential environmental impact of transporting, storing and utilizing gaseous and liquid fuels derived from coal.

6704 (DOE/ET/10154—112) **SRC-I Solvent-Refined-Coal Process: operation of the Solvent-Refined-Coal Pilot Plant, Wilsonville, Alabama. Operation of the Kerr-McGee Critical Solvent Deashing unit (June 1978-March 1981).** (Catalytic, Inc., Wilsonville, AL (USA)). Oct 1982. Contract AC22-76ET10154. 66p. NTIS, PC A04/MF A01. Order Number DE83002178.

This report summarizes the operation and performance of the Kerr-McGee Critical Solvent Deashing (CSD) unit at the six ton-per-day Solvent-Refined-Coal (SRC-I) Pilot Plant in Wilsonville, Alabama. The operating data and test results from June 1978 through March 1981 are detailed and analyzed. Various parameters affecting the performance of the CSD unit were studied. These parameters included: solids withdrawal at the SRC unit dissolver; the SRC unit dissolver pressure and temperature; the SRC unit high pressure separator residence time and temperature in the hot and normal modes of operation; the SRC unit solvent quality, with and without additions of light SRC (LSRC), to the process solvent; and use of selected CSD unit deashing solvents. Various sources of deashing solvent (DAS) losses were identified and the operation of the CSD unit was modified to minimize these losses. The first stage ash processing equipment was modified to produce a free-flowing ash concentrate with a minimal DAS content. Parameters affecting the deashing solvent content in SRC and LSRC products, as well as steam stripping of SRC and LSRC strippers, were investigated.

6705 **(DOE/ET/10703—1301) Coal pyrolysis by hot solids from a fluidized-bed combustor. Final technical report, June 1977-June 1982.** Longwell, J.P.; Evans, L.B.; Howard, J.B.; Peters, W.A.; Floess, J.K.; Fong, L.; Chen, C.; Yeboah, J. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1982. Contract AT01-76ET10703. 68p. NTIS, PC A04/MF A01. Order Number DE83003344.

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The effect of adding calcined dolomite stone to the fluidized-bed pyrolysis of coal and oil shale on product quality and product distribution has been studied. This work has provided information relevant to systems where heat is generated by fluidized-bed combustion in the presence of a sulfur acceptor (dolomite) and where the hot stone from the combustor is used in a second reactor to provide heat for pyrolysis. A scoping economic analysis indicated that, for coal, the pyrolysis gas and liquids produced are lower cost than gas and liquids produced by single-product gasification and liquefaction processes. The presence of calcium oxide during pyrolysis was found to improve gas heating value by CO_2 removal and to essentially eliminate H_2S. Gas yield was increased at the expense of liquid yield (20 to 30% reduction). Tar properties were improved by reduction of oxygen content, however, little sulfur or nitrogen removal was observed. Used stone from a fluidized-bed combustor gave results comparable to fresh stone with little reduction of the calcium sulfate present in the used stone. Since Colorado oil shale contains dolomite and calcite, stones from spent-shale combustion might be expected to have similar effects on product yields. CO_2 and H_2S removal from the gas were observed. Fortunately, liquid yields were not reduced within the 5% experimental error of this work. It is indicated that CaO tends to remove phenols and polycyclic aromatics which are present in much lower concentration in shale oil than in coal tar.

6706 **(DOE/METC/SP—190) Underground coal gasification of Eastern bituminous coal beds. Topical report.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Mar 1982. 24p. NTIS, PC A02/MF A01. Order Number DE83003043.

The goal of the US Department of Energy (DOE) Underground Coal Conversion (UCC) program is to develop the technology to produce clean fuels from coal deposits that are unsuitable for commercial exploitation by conventional mining techniques. The highest priority is to develop and demonstrate, in conjunction with industry, a commercially feasible process for underground gasification of low-rank coal in the 1985 to 1987 time period. The DOE program has stimulated industry interest and activity in developing UCC technology. Several major energy corporations and utilities have invested private funds in UCC research and development (R and D) projects. Results of the program to date indicate that, while UCC is technically feasible, it still contains some process unknowns, environmental risks, and economic risks that require R and D. In order to contribute to the national energy goals, a strong DOE program that incorporates maximum industry involvement is planned. The program's strategy is to remove the high-risk elements of UCC by resolving technical, environmental, and economic uncertainties. This will enable industry to assume responsibility for commercialization of the technology. Thus, the elements of the program have been designed to: provide detailed design and operational data that industry can scale-up with confidence; provide accurate and complete cost estimates that can be scaled-up and will allow comparison with alternative processes; provide detailed environmental impact and control data to allow industry to implement projects that will meet applicable standards; verify the reliability of continuous operation of UCC processes; and show that UCC processes have the flexibility to meet a variety of commercial needs.

6707 **(DOE/METC/SP—192) Surface coal gasification.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Feb 1982. 55p. NTIS, PC A04/MF A01. Order Number DE83003337.

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The United States Department of Energy recognizes the deficiencies in available gasifiers and associated process systems and the dilemma facing industry in developing improved gasification systems for vague markets. Thus, they sponsored development of second- and third-generation processes, at least through the pilot plant and process development unit (PDU) stages, in the Surface Coal Gasification Pilot Plant/PDU Program. Technology crosscut was addressed in METC's first topical report on Surface Coal Gasification (DOE/METC/SP-110, October 1980). The information and data presented in that first report are, for the most part, still valid. For this second report a slightly modified approach is taken with additional information provided. An updated comparison of four coal gasification pilot plants/PDU's summarizes the following common problems associated with generic unit operation areas: coal preparation, gasifier, gas cleanup, instrumentation, and materials. Some of the problems are considered in detail.

6708 **(DOE/METC/TPR—82-57) Effects of tubing composition on the transport of sub-micron aerosols.** Anderson, R.J.; Ward, H.L. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Sep 1982. 18p. NTIS, PC A02/MF A01. Order Number DE83002980.

The composition of tubing used to transport aerosols for extractive sampling or analysis can have a significant effect on the measured particle diameter and concentration. In an effort to quantify this effect and study possible methods of mitigation, four separate types of 1/4-inch O.D. tubing commonly used for aerosol transport were studied (i.e., stainless steel, tygon, polyflow, and natural rubber). The subject aerosol consisted of NaCl particles with a mean concentration of about 10^6 particles/cm^3 and a geometric mean particle diameter of about 0.02 microns with a standard deviation of 1.4. The size and the concentration of the transported aerosols were measured with an Electrical Aerosol Analyzer (EAA - TSI Model 3030) and a Condensation Nucleus Counter (CNC - TSI Model 3020), respectively. No effects of tubing type were apparent when the aerosols were passed through a radioactive charge neutralizer after transport through the test tubing. Stainless steel tubing gave the highest measured aerosol concentration in the absence of the charge neutralizer. During an initial conditioning interval, the measured aerosol concentration increased with time for all tubing types except stainless steel. As a result, presampling intervals of at least 30 minutes are recommended for conditioning of transport tubing to provide more consistent data. 5 figures, 5 tables.

6709 **(DOE/OR/05105—T1) Development of a process for ash removal from coal-derived liquids based on particle distribution to an aqueous phase. Final report, March 1, 1976-June 30, 1980.** Henry, J.D. Jr. (West Virginia Univ., Morgantown (USA)). 1980. Contract AS05-76OR05105. 123p. NTIS (US Sales Only). Order Number DE83002107.

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A dispersed water phase can be used to separate mineral matter from coal-derived liquids. A dispersed water phase can either be used to fully distribute the particles to that phase, to collect them at the water/oil interface, or to act as a bridging medium for further agglomeration. Extensive studies were conducted on mineral matter removal from solvent-refined coal. The mineral matter in coal-derived liquids has an asphaltic and preasphaltic coating which dominates its wetting characteristics. This was confirmed by three phase contact angle measurements and the electrical charge characteristics of the mineral matter in solvent-refined coal. Either surfactant wetting agents or a pH of 9 to 10 in the water phase can be used to wet the mineral matter of particles and to promote their association with the water phase. Particle transfer studies of asphaltic coated particles in model liquids such as xylene indicate that partial detergency of the asphaltic coatings occurs. This mechanism accounts for the fact that the extent of mineral matter separation decreases with mixing time in the water/oil/particle system. A mathematical model and experimental data on electrical coalescence of water droplets in oil suspension is primarily due to the enhanced electric field and corresponding rupture of the oil film between water droplets at drop separations which are greater than those when coalescence is done in the absence of an electric field. A patent resulted from this work on an improved electrostatical coalescence device which used combined AC and DC electric fields in conjunction with hyrophilic electrodes. Six appendices have been entered individually.

6710 (DOE/OR/05105—T1, pp 42-44) **Charge characteristics of particles in coal-derived liquids: measurement and origin.** Henry, J.D. Jr.; Jacques, M.T. (West Virginia Univ., Morgantown). 1980. NTIS (US Sales Only). Contract AS05-76OR05105.

In Development of a process for ash removal from coal-derived liquids based on particle distribution to an aqueous phase. Final report, March 1, 1976-June 30, 1980.

Particles present in the reactor effluent stream of all coal liquefaction processes consist of a mixture of the original mineral matter present in coal, that is, clays, SiO_2, FeS_2, $FeCO_3$, $CaSO_4$, $CaMg(CO_3)_2$, together with unreacted and partially reacted coal residues. These particles range in size from 0.1 to 100 μm and constitute up to 10 wt. % of the reactor effluent stream depending on the specific process conditions. Subsequent removal of this particulate matter represents one of the major process problems associated with coal liquefaction. This note summarizes measurements made on the sign of the charges associated with the particulate matter present in an unfiltered Solvent-Refined Coal liquid having an initial 3:1 solvent to coal ratio. The experimental investigation shows that the particulate matter present in coal-derived liquids exhibit appreciable electrophoretic mobility due to a net positive surface charge. The origin of the positive charge is explained in terms of the acid base structure of asphaltic species and the presence of protons in the coal-derived liquid. Corroborative experiments using quinoline to model the basic component of coal-derived asphaltenes confirm that a positive charge is conferred to particulate matter suspended in a hydrogen donor solvent. An understanding of the sign and origin of the charge on particles in coal-derived liquids should be of considerable interest to researchers currently investigating the feasibility of techniques such as flocculation, electrically induced separations, and interfacial collection or distribution to water for the removal of the particles.

6711 (DOE/OR/05105—T1, pp 45-52) **Mechanisms of transfer of hydrophobic coated mineral matter particles from a hydrocarbon to an aqueous phase.** Prudich, M.E. (Gulf Oil Research and Development Co., Pittsburgh, PA); Henry, J.D. Jr. 1980. NTIS (US Sales Only). Contract AS05-76OR05105.

In Development of a process for ash removal from coal-derived liquids based on particle distribution to an aqueous phase. Final report, March 1, 1976-June 30, 1980.

A solid/liquid separation process based on the transfer of hydrophobic coated mineral particles from a hydrocarbon to an aqueous phase is described. This process could be used, for example, to remove mineral matter from coal derived liquids in order to meet fuel specifications. A model system which involves hydrophobic, asphaltic, coated mineral matter particles in a model liquid, xylene, was used in conjunction with the mechanistic studies. The mineral matter distribution coefficient to the aqueous phase decreases rather than increases with time in batch experiments. Five asymptotic models based on the fate of the surface active chemical at long time are investigated. Included were adsorption on the mineral matter particle, adsorption at the oil/water interface, distribution of the surfactant to the aqueous phase, complete detergency, and partial detergency. Experimental data on the influence of surfactant concentration, contact time, water/oil ratio, and shear are consistent only with the partial detergency model.

6712 (DOE/OR/05105—T1, pp 53-83) **Electrically induced coalescence in dispersions: Part I. Theoretical development.** Hovarongkura, D.A.; Henry, J.D. Jr. 1980. NTIS (US Sales Only). Contract AS05-76OR05105.

In Development of a process for ash removal from coal-derived liquids based on particle distribution to an aqueous phase. Final report, March 1, 1976-June 30, 1980.

A mathematical model of dipole drop-drop coalescence in dispersions has been developed. Most previous analyses consider only the electrically induced coalescence of pairs of droplets as opposed to dispersions. Equal drop sizes and head-on collisions are assumed and both the AC and DC electric field case are considered. The coalescence frequency is the product of the collision frequency and the coalescence efficiency. Binary collisions are used for collision frequency calculations. The coalescence efficiency is a function of two random variables: coalescence time and drop contact time. The electric field enhancement that occurs when droplets approach at close separation, is responsible for the continuous phase film rupture at a large film thickness compared to coalescence in the absence of an electric field. Film stability calculations consider the effects of the electric field enhancement. The model is used to make parametric calculations which illustrate the effect of the electric field strength on the critical film thickness, the force of attraction between approaching drops, the drop contact time, coalescence time, and the coalescence efficiency. The model predicts that coalescence efficiency of the AC electric field is larger than of the DC electric field. This occurs because the drop contact times are longer in the AC electric field case. The model also suggests that coalescence efficiency is not sensitive to the drop diameter. An experimental investigation of electrically induced drop-drop coalescence in dispersions is presented in Part II.

6713 (DOE/OR/05105—T1, pp 84-111) **Electrically induced coalescence in dispersion: Part II. Experimental investigation.** Hovarongkura, D.A.; Henry, J.D. Jr. 1980. NTIS (US Sales Only). Contract AS05-76OR05105.

In Development of a process for ash removal from coal-derived liquids based on particle distribution to an aqueous phase. Final report, March 1, 1976-June 30, 1980.

The dipole drop-drop coalescence of a dilute water dispersion in a kerosene was investigated. An experimental technique based upon a selective drop separation by settling was developed. The continuous phase flow was directed upward and its flow rate was adjusted so that only larger coalesced drops would escape from the coalescing region by settling. The drop sizes were measured photographically and the volume mean drop diameter was used to represent drop diameter. Experimental artifacts in this study are presented and discussed. The experimental coalescence parameter was used to study the extent of drop-drop coalescence. It was found that the coalescence parameters with an AC electric field are always greater than of a DC electric field of equivalent strength. In both cases, the coalescence parameter increased with increasing electric field strengths. The AC electric field appears to be more effective than the DC electric field for promoting drop-drop coalescence; this confirms the theoretical analyses of Part I. The coalescence parameters for both AC and DC electric fields increase with increasing dispersed phase volume fraction, but the dependence of coalescence parameter on the dispersed phase volume fraction fails to yield the first power exponent as indicated theoretically. Increasing drop diameter trends to increase coalescence parameters of both the AC and DC electric field.

6714 **(DOE/PC/50041—1) Wilsonville Advanced Coal-Liquefaction Research and Development Facility. Technical progress report. Runs 238 and 239 with Illinois 6 coal.** (Catalytic, Inc., Wilsonville, AL (USA)). Nov 1982. Contract AC22-82PC50041. 110p. NTIS, PC A06/MF A01. Order Number DE83003389.

This report presents the operating results for Runs 238 and 239 at the Advanced Coal Liquefaction R and D Facility in Wilsonville, Alabama. These runs were made in an integrated two-stage liquefaction (ITSL) mode using Illinois 6 coal from the Burning Star mine. Run 238 began on 8 April and continued through 21 April. During this period, coal was fed continuously for 276 hours. One 24 hour special product workup or material balance (MB) period was selected and is analyzed herein. Run 239 began on 23 April and continued through 24 May. During this period, coal was fed continuously for 651 hours. Four 24 hour special product workup periods were selected and are analyzed herein. Runs 238 and 239 investigated: (1) the transient and steady-state response of the system when subjected to recycle of hydrotreated solvent refined coal; and (2) operability of the critical solvent deashing unit when deashing a highly soluble feed whose properties are changing during the transient period. 12 figures, 32 tables.

6715 **(DOE/RA/50351—1300-Vol.1) Crow Tribe of Indians: synfuels feasibility study. Volume I. Executive summary.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 254p. NTIS, PC A12/MF A01. Order Number DE83001402.

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This study presents the feasibility of using the abundant natural coal resources of the Crow Tribe of Indians to produce and sell substitute natural gas (SNG) from their Montana reservation. Four cases of an SNG production capacity of 125 million standard cubic foot per calendar day (expandable to 250 MMSCF/CD) are analyzed as to coal supply, coal transportation, raw water supply, solid waste disposal and site selection and prepartion. All cases use the proven Lurgi coal gasification technology. An SNG and by-product market analysis is made and a cost-of-service for the cases is determined. Environmental impact, health and safety requirements, socioeconomic aspects, and legal constraints are examined and discussed. The financial opportunities and risks offered potential energy investors are weighted heavily by current economic conditions and a soft fuels market. The project is technically and environmentally feasible. The uncertainty of energy markets and supply, however, makes it impossible to make the financial commitment required to move the project forward at this time. Therefore, it is recommended that the project be delayed indefinitely. In addition, there are a number of steps identified that the Crow must take to attract equity investors if the project is to proceed at some future date.

6716 **(DOE/RA/50351—1300-Vol.2-Bk.1) Crow Tribe of Indians: synfuels feasibility study. Volume II. Process design and cost estimate. Book I. Sections 1.0 through 6.2.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 411p. D. Order Number DE83000482.

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Volume II covers the Engineering and Cost Analysis. The Engineering portion describes in detail the process units within the Base Case. Also covered are three alternate cases where they deviate from the Base Case and the three special process studies. The screening studies that defined the parameters of the Base Case are examined. Economic criteria, primarily for the Base Case, are established and evaluated. Then cost estimates (capital and operational) are presented. Because of the amount of material presented, Volume II is divided into three separate books.

6717 **(DOE/RA/50351—1300-Vol.2-Bk.2) Crow Tribe of Indians: synfuels feasibility study. Volume II. Process design and cost estimate. Book II. Sections 6.3 and 6.4.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 466p. NTIS (US Sales Only). Order Number DE83000483.

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6718 **(DOE/RA/50351—1300-Vol.2-Bk.3) Crow Tribe of Indians: synfuels feasibility study. Volume II. Process design and cost estimate. Book III. Sections 6.5 through 6.9.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 474p. NTIS, PC A20/MF A01. Order Number DE83001314.

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The principal difference in the design for the Coproduction Case is that methanol and substitute natural gas (SNG) are the major products as opposed to only SNG in the Base Case. The pure syngas is fed to a methanol synthesis unit producing methanol which is purified. The purge gas from the Methanol Synthesis unit is converted to SNG by methanation. Other process and utility/offsite units are similar to the Base Case except there is no requirement for a CO Shift unit and there is a slight variation in size of some units to accommodate the change in processing scheme. Coal feed to gasification and boilers is identical to the Base Case. Feed and product rates for this case are given in Section 6.5.2. Other than the methanol and SNG products, the byproduct rates are only marginally different from the Base Case. Power available for export is less than the Base Case, due mainly to the additional energy consumed in the Methanol Synthesis unit.

6719 **(DOE/RA/50351—1300-Vol.3) Crow Tribe of Indians: synfuels feasibility study. Volume III. Part A: financial analysis. Part B: legal analysis.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 204p. NTIS, PC A10/MF A01. Order Number DE83001362.

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The Crow Synfuels Project, one of the largest synthetic fuels projects currently active, is projected to cost $3.15 billion in construction costs with capitalized interest of $518 million. Total financing requirements will be $3.66 billion including inflation. The economics and risks of the Synfuels Project are such that the Project needs both loan guarantees and price guarantees from the Synthetic Fuels Corporation in order to be viable. A price guarantee at a 1982 price of $6.75 plus escalation would yield a 27% rate of return under the assumptions used in this study. With this level of price guarantee, the Project exceeds the $3 billion funding limit of the Synthetic Fuels Corporation. Therefore, the Project as proposed is not feasible unless private non-guaranteed financing is available or if it is financed with substantially greater equity than the 25% contemplated. Without increased private participation in the Project, only a substantially smaller project can meet the limits of the Synthetic Fuels Corporation guarantees. The Synthetic Fuels Corporation currently has 14.9 billion dollars in authority and cannot fund numerous large projects. The Board of Directors has decided to seek a diversity of projects. This Project is very similar to the Great Plains Project. As a result it might be difficult to receive government assistance for the Project even at a smaller scale.However, the Crow Tribe has one of the premier sites for a synfuels project. A smaller project could be accomplished under the existing government program. The Crow Tribe should take those steps necessary to attract other, smaller projects to this site.

6720 **(DOE/RA/50351—1300-Vol.4-Pt.A) Crow Tribe of Indians: synfuels feasibility study. Volume IV. Part A. Environmental.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 576p. NTIS (US Sales Only). Order Number DE83001204.

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The final assemblage of environmental baseline data in this report includes pertinent information on the Crow Reservation in the following major areas: climatology and air quality, surface water and groundwater quantities and quality; physiography and land use; soils and vegetation; wildlife resources; geology; seismology; and cultural resources (archaeology). The foregoing environmental baseline information provided the natural background for the subsequent assessment of potentially adverse environmental impacts at Sites 1 and 23 based on two selected plant design scenarios for the proposed Crow synfuels plant. Recalling that the most stringent environmental impacts for this feasibility study are imposed by the Class I air quality designation for the adjacent Northern Cheyenne Reservation, emphasis was placed upon a more detailed evaluation of design emission control requirements for mitigating these potential air quality impacts. In addition to confirming compliance with SO_2 and particulate matter Class I PSD increments, the second phase of the air dispersion modeling analysis investigated the implications of the GEP stack height regulations recently promulgated by EPA in terms of the sensitivity of SO_2 emission control efficiencies to plant physical stack height. Emphasis was placed upon SO_2 emission control efficiencies for the boiler plant for several reasons, which are discussed.

6721 **(DOE/RA/50351—1300-Vol.5) Crow Tribe of Indians: synfuels feasibility study. Volume V. Special studies.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 339p. NTIS, PC A15/MF A01. Order Number DE83002020.

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The Crow Synfuels Project has two excellent feed coal sources that can be considered. The coals from both sources are similar in quality and the total tonnage required owing to the different gasification characteristics of each coal is almost identical. Westmoreland is presently operating a mine producing coal in

quantities comparable to what the synfuels plant requires so they know what the actual mining costs are. They have the equipment available and an approved mining plan to proceed with supplying coal to the synfuels plant within a year after signing a contract. Shell is well along with developing their mining project by virtue of having submitted their environmental impact report. Shell plans to have the mine in full operation in 1986 which will easily meet the requirements of the startup schedule proposed for the synfuels plant. The Shell coal costs are considerably higher than the Westmoreland coal costs, but Shell has the advantage that the synfuel plant can be located near the minemouth. The final ranking of the coal supply can only be done after evaluating coal transportation, water supply, access roads, site preparation, and differences in process plant requirements. In Part 2 of Volume 5, the market for by-products of the proposed plant in the Rocky Mountain region are analyzed.

6722 **(EPRI-AP—2645) Phase formation during supercritical solvent deashing of solvent-refined coal. Final report.** Henry, J.D. Jr.; Verhoff, F.H. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Nov 1982. 255p. NTIS, PC A12/MF A01. Order Number DE83900749.

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A constant volume high temperature - pressure phase contacting cell was used in conjunction with an x-ray measurement technique to experimentally determine the volumes of the phases that are formed when supercritical solvents are contacted with solvent refined coal. A material balance technique is used in conjunction with the x-ray data to determine the mass of the phases. The constant volume technique can be used to independently vary temperature and pressure. In addition to temperature pressure variation, the ratio of solvent to solvent refined coal was a major parameter in this investigation. Solvent/W. SRC ratios of 2, 3 and 4 were investigated. Experiments were conducted on the following five systems: Wilsonville Solvent Refined Coal (W. SRC) - Heptane, W. SRC - Toluene, W. SRC - Pyridine, Asphaltene - Toluene and Preasphaltene - Toluene. Pyridine dissolved virtually all of the solvent refined coal. Toluene dissolved intermediate quantities and Heptane dissolved the least. A solubility maximum was observed with the W. SRC - Toluene system. The maximum solubility occurred significantly below the critical point of toluene and at temperatures above the critical point, dissolved solutes were rejected. Qualitatively the same behavior was observed with the asphaltene - toluene system. Toluene did not dissolve preasphaltenes. The maximum solubility with the W. SRC - Toluene system was found to be pressure insensitive at a toluene/W. SRC ratio of 3:1. At a ratio of 4:1 the maximum solubility was more pressure sensitive. 50 figures, 45 tables.

6723 **(NP—2906253) Hydropyrolysis of model coals.** Schaub, G. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemieingenieurwesen). 14 Dec 1979. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82906253.

Thesis.

In order to investigate the secondary reactions of fragments occurring in the thermal coal decomposition, a carbon-containing carrier material was used on which a model substance characteristic for volatile sulphur products (4 different alkyled mono and binuclear aromatics, a phenol) was placed. This model coal was carbonized at low temperature under hydrogenating conditions, where product yields and composition depending on H_2 pressure (between 5 and 100 bar) and temperature (between 565 and 740°C) were determined by gas chromatography. The results of the model systems considered were compared with those of the hydropyrolysis of a Saar gas flame coal. The competing splitting and formation reactions are described by a simple model where the non-converted quantity of model substance is considered depending on the H_2 pressure.

6724 **(NP—3900133) Degassing and hydrogenating gasification of bituminous coal in the pressure range of 0.1 to 90 bar at heating rates of 10^2 to 10^3 K/s.** Arendt, P. (Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 30 Jun 1980. 155p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83900133.

Thesis.

Pyrolysis and hydrogenating gasification of different types of coal of the overall carbonization range, as well as their role in heating rates of between 50 and 1000 K/s and pressures upto 90 bar, as well as varying grain size, have been investigated. A special wire netting technique was used here which when introducing 10 mg of coal heats up the whole sample amount at a regular temperature course. The tar produced is deposited onto Al foils, the product gas analyzed by mass spectroscopy for H_2, CH_4, C_2H_2, C_2H_6, CO and CO_2. The reaction course in a single grain was observed with a high-speed camera allowing conclusions to be drawn about the baking behaviour of the coal. The product balances were measured in He and H_2 atmosphere during pyrolysis. The results are discussed refering to a radical reaction mechanism. Kinetic parameters determined by a special method are used for the design of a fly dust reactor for pyrolysis.

6725 **(NP—3900335) Investigations on the heterogeneous catalyzed hydrogenation of carbon monoxide (Fischer-Tropsch Synthesis).** Gantz, U. (Bochum Univ. (Germany, F.R.). Abt. Chemie). 12 Mar 1980. 207p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE83900335.

Thesis.

The formation of short-chain hydrocarbons on a sintered iron/manganese catalyst is investigated in this work. This sintered catalyst, contrary to a precipitation catalyst exhibits the same chemical composition, a higher selectivity of short-chain olefins. The Fischer-Tropsch synthesis takes place in a temperature range of 255 to 333°C and at pressures of up to 20 bar. The part system ethylene/ethane was closely examined by adding ethylene. It was shown that paraffins and olefins probably have the same precursor which yields olefins by eliminating hydrogen and by hydrogenation to form paraffins. The evaluation of measured results (conversion considering the kinetic parameters) gives a formal kinetic description of the reaction rates which can be transferred to a large scale reactor and desired product optimization.

6726 **(DOE/RA/50351—1300-Vol.4-Pt.B-C) Crow Tribe of Indians: synfuels feasibility study. Volume IV. Part B: health and safety. Part C: socioeconomics.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Crow Tribe of Indians, Washington, DC (USA)). Aug 1982. Contract FG01-81RA50351. 254p. NTIS (US Sales Only). Order Number DE83000439.

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This comprehensive assessment provides the basis for identifying potential hazards and recommending controls that should be considered in the proposed plant. The following conclusions are drawn from the health and safety assessment: (1) It is important to anticipate health and safety issues at the early stage of technological development. Their integration into the design and operation of a plant can prevent potential problems and reduce costs by optimizing process/control interfaces and minimizing retrofit needs. (2) The nature of health and safety hazards, engineered controls, work practices and protective equipment and clothing in a synfuels plant are similar to those found in industries such as petroleum refining, petrochemicals and coal chemicals. Additional health and safety measures will be practiced to alleviate the concerns about the larger numbers and increased concentrations of potential carcinogenic compounds associated with the coal gasifier. (3) Maintenance and repair operations are the main source of worker exposure to process materials via inhalation and dermal routes of contamination. This is consistent with findings of many industrial operations. Therefore, in order to reduce potential risks to workers, consideration of exposures during maintenance and repair should be included in the final engineering design. This analysis supports the conclusion that Site 1 is preferred over Site 23, from a socioeconomic standpoint.The projections presented in this analysis rest on a host

of data and assumptions concerning manpower needs, the availability of local Indian and non-Indian labor, manpower competition from other projects, household sizes, the spatial distribution of households, and the service requirements and costs of new populations.

6727 **Coal gasification; combustion chemistry.** Washington, D.C.; American Chemical Society (1982). 319p. (CONF-820304—Vol.2). University Microfilms, 300 North Zeeb Road, Ann Arbor, MI 48106 $8.00.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The spring meeting of the Division of Fuel Chemistry of the American Chemical Society was held at Las Vegas, Nevada, March 28 to April 2, 1982. The papers mainly concerned coal gasification and fluidized-bed combustion. Thirty-one papers from Volume 27, No. 1 of the preprints have been entered individually into EDB and ERA. (LTN)

6728 **Coking properties of coal at elevated pressures.** Lancet, M.S.; Sim, F.A.; Curran, G.P. (Conoco Coal Development Co., Library, PA). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 1-24(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Conoco's experience with the gasification of Pittsburgh No. 8 and Ohio No. 9 coals in Westfield, Scotland has suggested that the coking properties of these coals, and other Eastern US coals by inference, under increased pressure are different from those normally measured at one atmosphere. The work reported involves the operation of a pressurized coker, a pressurized Gieseler Plastometer and a device for measuring the Pressurized Swelling Index (PSI). The results of testing various coals by these methods are particularly useful in the evaluation of said coals for use in both dry and wet bottomed Lurgi gasifiers. Seven coals, covering a fairly wide range of ranks and characteristics, were included in this work. The experimental data presented herein should provide a start on the required data base which will ultimately permit the prediction of the coking properties of coals being considered as potential gasifier feedstocks. The limited data obtained pertaining to pyrolysis yields and gas composition are encouraging and suggest that accurate gas yield predictions may also be possible at the conclusion of this program. The effects of process variables on coal swelling and fluidity have been fairly well established, but more work is needed to get predictive mathematical correlations of these as well as coking and pyrolysis properties of coals.

6729 **Effects of preoxidation on pyrolysis behavior and resultant char structure of caking coals.** Maloney, D.J.; Jenkins, R.G. (Pennsylvania State Univ., University Park). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 25-30(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Coal gasification processes may be divided into two stages. They are, the initial rapid release of volatile matter and the relatively slow gasification of the residual char. These two processes are not, however, totally independent because the heat treatment conditions under which coal pyrolysis occurs determine, to a large extent, the structure and reactivity of the remaining char. The work described here is concerned with the utilization of bituminous (caking) coals in dilute phase, rapid heating gasification and combustion system. Two highly caking coals were pyrolyzed in an entrained flow tube furnace system and devolatilization kinetics determined for each coal at temperatures of 900 and 1000°C. Structural properties of the chars were then analyzed. In addition, the effects of mild preoxidation of these coals upon their subsequent pyrolysis behavior were examined. Samples of each coal were oxidized to various levels prior to heat treatment. The sharp contrast in macroscopic properties of the chars collected in this study give rise to several important questions regarding char gasification. Varying heat treatment conditions and coal feed stocks give rise to chars of widely varying structure. In order to understand the behavior of these materials in subsequent gasification steps a more detailed analysis of char structure is required. At present microstructural properties (surface areas, porosities) of the chars generated in this study are being examined in an effort to better understand the relationship between char structure and heat treatment conditions. Results of this work will be available shortly.

6730 **Influence of particle structure changes on the rate of coal char reaction with CO_2.** Debelak, K.A.; Clark, M.A.; Malito, J.T. (Vanderbilt Univ., Nashville, TN). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 31-40(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

A common feature of gas-solid reactions is that the overall process involves several steps: (1) mass transfer of reactants and products from bulk gas phase to the internal surface of the reacting solid particle; (2) diffusion of gaseous reactants or products through the pores of a solid reactant; (3) adsorption of gaseous reactants on solid reactant sites and desorption of reaction products from solid surfaces; (4) the actual chemical reaction between the adsorbed gas and solid. In studying gas-solid reactants, we are concerned with these four phenomena and other phenomena which affect the overall rate of reaction and performance of industrial equipment in which these gas-solid reactions are carried out. These other phenomena include: heat transfer, flow of gases and solids through reactors, and changes in the solid structure, all of which affect the rate of diffusion and surface area available for reaction. Devolatilization causes structural changes reflected in an average weight loss of 41%, a decrease in the diffusion coefficient, and an increase in total surface area. The increase in surface area represents the opening of pores not accessible before devolatilization. This new pore structure has a greater resistance to diffusion. The small pores and enlarged pore form a more complex network of voids within the particles. The devolatilization causes an increase in total available surface area and a decrease in the diffusion coefficient. The heterogeneous chemical reaction causes continuous changes in the pore structure due to the consumption of carbon.

6731 **Entrained flow reactor with in situ FTIR analysis.** Solomon, P.R.; Hamblen, D.G. (Advanced Fuel Research, Inc., East Hartford, CT). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 41-49(1982). (CONF-820304—Vol.2). Contract AC21-81FE05122.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Preliminary results have been obtained in a newly constructed Entrained Flow reactor with on-line in-situ analysis by FTIR. These results indicate that: (1) gas concentration measurements for CO, CO_2, water, methane, acetylene, ethylene, and heavy paraffins can be routinely made in a hot furnace with an FTIR; (2) gas temperature measurements appear feasible using ratios of CO lines; (3) on-line gas analysis in an external gas cell is also extremely effective. Several observations which have previously been reported for other pyrolysis experiments appear to be supported by the preliminary data. These are: (1) gas kinetics appear to be relatively insensitive to coal rank; (2) the gas composition varies systematically with the functional group composition of the coal; (3) there is temperature dependent cracking of paraffins to form olefins and acetylene and of olefins to form acetylene; (4) functional groups in the chars disappear in the following order: first aliphatics, then hydroxyl, and then aromatic hydrogen and ether linkages. The present results show that carboxyl groups also disappear quickly.

6732 **Coal pyrolysis at high temperatures and pressures.** Tamhankar, S.S.; Sears, J.T.; Wen, C.Y. (West Virginia Univ., Morgantown, WV). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 50-56(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

In coal conversion processes, such as combustion or high-temperature gasification, the extent of pyrolysis is an important parameter which is affected by temperature. Increasing amounts of coal converted directly to gaseous species would reduce the remaining material which must be converted by the relatively slow char-gas reactions. Studies on this aspect, particularly at pressure and high temperatures, are scarce. To help fill in the data gaps, the

present work has therefore been focused on the examination of pyrolysis at high temperatures (800 to 1600°C), pressures (1 to 15 atm) and in various reacting and nonreacting gases. Devolatization generally increases with temperature in a manner consistent with the proposed three-stage mechanism for the evolution of volatiles. Results here show a plateau at 1200 to 1400°C and a maximum devolatilization above 1500°C. Reactive gases can interact with the freshly formed volatiles and affect the secondary char-forming reactions which can cause changes in the apparent percent pyrolysis. This was evident from the effects of moisture content, particle size, pressure and gaseous environment on the extent of pyrolysis. Reactivity of char formed in-situ and immediately reacted was found to be higher than reactivity of chars formed separately and then brought into the reactive environment. It is suggested that morphological rearrangements may be important in pyrolysis and subsequent char reactions.

6733 **Simulation of entrained flow hydropyrolysis reactors.** Goyal, A. (Inst. of Gas Technology, Chicago, IL); Gidaspow, D. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 57-66(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The phenomena of coal pyrolysis and hydropyrolysis have become of considerable interest in recent years because of their significance in the efficient conversion of coals to clean fuels. The proposed hydropyrolysis commercial reactors are usually based on the entrained flow concept in which coal particles are rapidly heated in a dilute phase by mixing with hot hydrogen (or a gas mixture rich in hydrogen). A wide variation in the product distribution can be obtained in such reactors by manipulating temperature, residence time, and other operating parameters. Mathematical models incorporating hydrodynamics, coal kinetics, heat transfer characteristics, etc. are needed for understanding the influence of design variables, feed materials, and process conditions on the reactor performance. The literature is lacking in coal hydropyrolysis entrained flow reactor models. Such a model has been developed in this study.

6734 **Effect of potassium carbonate on the gasification of Illinois No. 6 coal.** Pulsifer, A.H. (Iowa State Univ., Ames, IA); McGehee, J.F.; Saroff, L.;. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 67-73(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Catalyzed coal gasification can lead to reduced gasifier size and lower gasification temperatures which give greater thermal efficiencies. Therefore, an investigation of the steam gasification of a bituminous coal under moderately high pressures was conducted. The primary objective of the study was to determine the influence of an alkali metal carbonate catalyst on the kinetic parameters of the gasification reaction. The coal chosen for the study was an Illinois No. 6 coal and this material was gasified both with and without the addition of potassium carbonate. Experiments were carried out at temperatures between 700 and 900°C and at a pressure of 2.17 MPa (21.4 atm). The partial pressures of steam, carbon dioxide and hydrogen were also varied during the investigation. The carbon gasification rate was modeled using an unreacted, shrinking-core model and kinetic constants and activation energies were determined. The overall gasification reaction was found to be first order with respect to steam concentration, with the rate being unaffected by CO_2 and inhibited by hydrogen. The variation of gasification rate with carbon conversion was described by the unreacted, shrinking-core model, with the rate constants for runs catalyzed by K_2CO_3 being about four times those for uncatalyzed runs. The activation energies for the catalyzed and uncatalyzed runs were 134 and 152 kJ/mol, respectively. The principal products of both catalyzed and uncatalyzed steam gasification were H_2 and CO_2. The water-gas shift reaction reached equilibrium for most experiments at 900°C and some at 800°C, with the presence of K_2CO_3 having little effect on the approach to equilibrium.

6735 **Catalytic effects of alkali metal salts in the gasification of coal char.** McKee, D.W.; Spiro, C.L.; Kosky, P.G.; Lamby, E.J. (General Electric Corporate Research and Development, Schenectady, NY). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 74-86(1982). (CONF-820304—Vol.2). Contract AC21-80MC14591.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

This paper describes the results of a continuing study of the catalytic behavior of salts of the alkali metals in the gasification of coal char by steam and CO_2. The main purpose of this work is to investigate possible mechanisms of the catalysis and to elucidate the effects of mineral impurities on the reactivity of coal char. For this purpose the behavior of a typical char and a pure graphite powder have been compared in the presence and absence of added alkali catalysts. In a companion paper, the effects of char pyrolysis temperature, surface area and mode of catalyst addition are described. The reactivities of coal chars are obviously strongly influenced by a number of factors such as charring temperature and thermal history, pore size distribution and the presence of ubiquitous mineral impurities. However, the catalytic behavior of additives such as the alkali metal carbonates is similar for char and graphite and the same mechanisms probably operate in both cases. The main effect of the salt catalysts in both gasification reactions is to increase the pre-exponential factor of the rate equation. Changes in the apparent activation energy are small from catalyst to catalyst and on increasing the salt concentration. The most likely explanation of this effect is that the salt reacts with the char substrate to produce active sites on the surface where gasification can proceed. Increasing the amount of salt present increases the effective concentration of these active sites up to the point at which the surface becomes saturated. A plausible mechanism which has been proposed previously to account for the catalytic effects of Na_2CO_3 and K_2CO_3 in these reactions is shown in Table II.

6736 **Kinetics of potassium catalyzed gasification.** Knoer, P.; Wong, H.W. (Exxon Research and Engineering Co., Baytown, TX). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 87-97(1982). (CONF-820304—Vol.2). Contract AC01-78ET13005.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The present study was conducted to investigate the gasification reaction under commercially representative conditions. Thus, pressure was varied from 100 to 3500 kPa and hydrogen concentration was varied from 0 to 60%. Other reaction conditions, such as temperature and catalyst loading, were also varied to check published results at these more representative conditions. The data from this study were combined with mechanistic information from the literature. Only one kinetic model was found which fit both the data and the literature mechanism. The two adjustable constants for this model were and regressed using over 1200 pieces of data. The potassium catalyzed gasification of Illinois No. 6 bituminous coal was found to fit a Langmuir-Hinshelwood type kinetic model. This model provides a good fit to fixed bed and miniature fluid bed data over pressures ranging from atmospheric to 3500 kPa and over broad ranges of gas composition. The model closely predicted the observed flow rates of each specie in the product gas over a range of an order of magnitude or more. This model is consistent with the surface oxide mechanism for the steam-carbon reaction which was proposed in earlier literature. A sophisticated statistical regression technique was used to choose the two adjustable constants for this model by comparison with over 1200 pieces of data. The kinetic constants were regressed from data taken over the range of practical commercial interest. This kinetic model may be combined with independently verified correlations for bubble growth and mass transfer in a fluidized bed and used directly to study larger pilot plant data or scale-up issues.

6737 **Direct methanation: a new method of converting synthesis gas to substitute natural gas.** Meyer, H.S. (Gas Research Inst., Chicago, IL); Hill, V.L.; Flowers, A.; Happel, J.; Hnatow, M.A. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 109-115(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

In 1979, a new family of catalysts, the GRI Series 400 and 500 catalysts, were developed that promote the direct methanation reaction rather than the water-gas shift reaction. These catalysts provide the key to the new direct methanation process. The overall project objective was changed to reflect this breakthrough, and subsequent work concentrated on developing a direct methanation process. The present series of catalysts are the most active catalysts yet developed. These catalysts can operate with feed gases containing high levels of sulfur compounds and CO_2. Carbon formation has not been observed, even with H_2/CO ratios as low as 0.1 and with no steam addition, and the catalysts have high maximum operating temperatures. The catalysts are very easy to handle; they can be exposed to air at room temperature with no loss of activity, and therefore, they require little or no pretreatment. Direct methanation processes utilizing the CRC catalysts could potentially realize the following advantages over existing technology: reduced plant investment, operating costs, and gas costs; effective hydrogen utilization; one acid gas removal step; smaller acid gas removal feed stream; higher energy efficiency; sulfur tolerance; carbon fouling tolerance; lower process steam requirements; and decreased heat exchange area.

6738 **Construction of a 15 t/h-prototype plant for the VEW-coal-conversion-process.** Deggim, D.; Karger, R. Bonn, Germany, F.R.; Bundesministerium fuer Forschung und Technologie (Dec 1981). 58p. (In German). (BMFT-FB-T—81-216). Bundesministerium fuer Forschung und Technologie, Bonn, Germany.

After operating a 1 t/h pilot plant successfully for more than 5 years VEW decided to construct a prototype plant. The prototype plant will have a through-put of 15 t/h hard-coal. The prototype plant includes the most important units of the VEW coal conversion process, like gasification unit, gas cleaning unit and steam- and power-generation. The gasification unit consists of the following sections: coal milling and drying, gasifier and waste heat recovery, air-preheating and gas/char-separation. The gas cleaning unit includes the gas cooling section and the final dust recovery, the H_2S-removal, the salt splitting and the evaporation unit. The gasification and gas cleaning section is downstream followed by a steam boiler, where the generated products are burnt. The simultaneously produced steam is processed in the already existing steam turbine.

6739 **Gasification of domestic fuels in fixed bed. Literature review.** Jantunen, M.; Asplund, D. Espoo, Finland; Valtion Teknillinen Tutkimuskeskus (Oct 1981). 52p. (In Finnish). (VTT-TIED—81-46). Valtion Teknillinen Tutkimuskeskus, Espoo, Finland. Order Number DE82750318.

The knowledge concerning the oldest and best known gasification method - gasification in a fixed bed - is reviewed. Different types of gas generators are briefly reviewed, fuels used in fixed bed gasification and the design of the equipment, including the actual gas generator, are discussed, and finally a number of potential applications are presented.

6740 **Preliminary study on the construction of an industrial-scale coal hydrogenation plant.** Gelsenkirchen-Buer, Germany; VEBA Oel A.G. (1981). 22p. (In German).

The large-scale hydrogenation of black coal according to the further-developed Bergius-Pier-process with heavy oil conversion can be technically realized in the Federal Republic of Germany, but it cannot be realized economically on the basis of German black coal. Also the practice with imported coal and heavy oil is not acceptable for a private-economy enterprise. The realization of this project can be called in question anyway by political resistance as to individual sites and by the Amendment on air pollution abatement being discussed at present having as a consequence the expected more stringent licensing conditions.

6741 **Gasification of peat: a literature review.** Leppamaki, E.; Asplund, D.; Ekman, E. (Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). pp 291-327 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Gasification of solid fuels has become actual during the last few years as a consequence of the changed price development of fuels. This literature review contains information about the processes in which peat has been gasified. These processes are divided into two groups, commercial and noncommercial ones. The former group includes Lurgi, Koppers-Totzek, Winkler, and the usual generator gasifying (for example, a Soviet sod peat gasifier) processes. The latter group includes processes designed for peat gasification or research results obtained from experiments with peat in the laboratory or on a pilot-plant scale. Different peat forms, such as sod and milled peat and peat briquettes, have been objects of research. All the experiments reviewed in this study were made before the 1960's, and the aim was to collect information on these experiments for the planning of peat gasifying tests to be performed in the near future.

0105 By-products

REFER ALSO TO CITATION(S) 6845, 6974, 7088

6742 **(BMFT-FB-T—81-221) Preliminary investigations on the injection of a coal-oil-slurry into the blast furnace.** Rejek, U.; Franke, F.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750409.

Determination of the flow and pumping behaviour and sedimentation of coal-oil-slurries as a function of concentration, temperature, coal and oil type, grain size, size distribution, pipe geometry etc. The results of these investigations are intended to facilitate the planning of an injection plant and to enable an assessment of the economic feasibility of such a plant. The test results in a rotation viscosimeter, a circuit plant and in a pendulum apparatus as used in determining settling in coal-oil-slurries showed that for trouble-free transportation i. e. without undue increase in viscosity the maximum coal-concentration is 50% by weight with lignite coal-oil-slurries and 65% by weight with bituminous low volatile coal-oil-slurries at 80°C. A fine grinding of the coals dsub(K) $<$ 0,1 mm leads to high viscosity in the slurries. The utilization of coarse particles dsub(K) $>$ 1 mm leads to a rapid sedimentation at low velocities.

0106 Properties

REFER ALSO TO CITATION(S) 6721, 6858, 8049, 8050, 8309

6743 (CONF-8105173—, pp 14p, Paper 46) **Trace elements in Canadian coals.** Landheer, F.; Labuda, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The main studies on coal have emphasized the impact of sulfur oxides on the environment. These studies have considered either processing the coal to reduce the sulfur content or desulphurizing the combustion gases. It is anticipated that the future focus for the consideration of the coal cycle may be the environmental impact of heavy metals. To be prepared for dealing with this problem, samples from 42 coal fields in Canada were analyzed for 42 elements.

6744 **(DOE/ET/10638—T1) Application of Diels-Alder reaction to coal fractionation. Final report.** Yen, T.F. (University of Southern California, Los Angeles (USA). School of Engineering). [nd]. Contract FG01-77ET10638. 75p. NTIS, PC A04/MF A01. Order Number DE82016127.

Portions of document are illegible.

Several conclusions can be drawn from the results: (1) from the swelling experiments for maximum swelling to occur, the solvent must interact with the soluble matter in the coal. When the soluble material is removed, swelling is suppressed. The extractable portion can be thought of as the uncross-linked coal molecule; its structure can be determined without using destructive chemical

methods to break the coal apart; (2) hydrogen bonding is an unsymmetrical interaction, involving a donor and an acceptor. Strong hydrogen bonding solvents appear to compete with specific sites in both the coal (swelling) and the coal liquids (dissolution). The solvents with poor hydrogen bonding capability interact mainly through physical forces. For the moderate hydrogen bonding solvents there may be both kinds of interaction. Since the goal is to interrupt as wide a range of forces as possible in both the coal and coal liquid, it appears that a solvent with moderate hydrogen bonding capability should be selected.

6745 **Variations in the inorganic chemistry of coal.** Fyfe, W.S. (Univ. of Western Ontario, London, Canada); Kronberg, B.I.; Brown, J.R. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 116-123(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Here discussion is confined to the coal chemistry of the transition metals, some of which are known to play catalytic roles in coal combustion, and to the coal chemistry of the halogens. The presence of F and Cl at the per cent levels in some coals is significant for combustion technologies (concerned with corrosion problems, etc.) and for problems related to atmospheric emissions. The analytical data reported pertain to samples of raw coal, ash from coal, lignite and tar sand, as well as NBS standard reference coals and coal ash. The non-reference coals are bituminous coals from Western Canadian mines, hosted in Cretaceous formations. The lignites are from North Dakoga and Ontario, and the tar sand from Fort McMurray, Alberta. The British Columbia coals are from different seams in the same mine, as are the Alberta coals. The analytical techniques employed in all these studies are spark source mass spectroscopy (SSMS) and electron spectroscopy for chemical analysis (ESCA). The concentrations, obtained by SSMS, of transition metals and halogens for some North American coals and coal-related materials are compared to data available for coal from various sources and to crustal abundances.

6746 **Analysis of sub-micron mineral matter in coal via scanning transmission electron microscopy.** Allen, R.M. (Sandia National Labs., Livermore, CA); VanderSande, J.B. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 124-130(1982). (CONF-820304—Vol.2). Contract AC04-76DP00789.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The Scanning Transmission Electron Microscope (STEM) is an instrument well suited for the characterization of the sub-micron sized mineral matter in coal and can also be used to identify inorganic elements atomically bound in the organic coal matrix. For the three coals studied, a random survey was taken of mineral inclusions < 100nm in mean diameter observed within coal particles in powdered coal samples. The results indicate that the predominant mineral species making up these inclusions differ from those species predominating in mineral particles at larger size ranges. Two of the coals examined showed characteristic matrix signatures of inorganic elements which were observed in $\geq 90\%$ of the matrix areas examined. The third coal did not. All three coals exhibited various elements with $Z \geq 11$, most notably S, which were only irregularly associated with the matrix signal (i.e., found $<50\%$ of the time). For all three coals, the predominant mineral species observed in the ≤ 100nm size range would not be predicted from the results of the chemical analyses of the high temperature ash of the coals. None of the major elements ($Z \geq 11$) observed (with the exception of sulfur in the Ba, s-rich particles) constitutes more than 10% of the HTA for the respective coals; indeed, Ba, in the lignite, Ti in the bituminous coal, and Ca in the semianthracite all make up less than 1% of the respective ashes. Encountering these elements as the major constituents in the predominant mineral species observed in a random sampling of particles <100nm in diameter indicates that the distribution of inorganic elements must not be uniform over all size ranges of mineral inclusions. In particular, for all three coals, the predominant mineral species observed in the <100nm size range must therefore differ from those species predominating at larger size ranges.

6747 **Determination of mineral distributions in bituminous coals by electron microscopy.** Harris, L.A. (Oak Ridge National Lab., TN). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 131-137(1982). (CONF-820304—Vol.2). Contract W-7405-ENG-26.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

In recent transmission electron microscopical studies of coals, ultrafine minerals were observed (<1 μm). The observation and identity of these submicron minerals would have been difficult to achieve by use of the scanning electron microscope (SEM). However, the scanning transmission electron microscope (STEM) with energy dispersive x-ray analysis is an ideal analytical tool since it is capable of supplying elemental and diffraction data for particles as small as 30 nm in diameter. In this paper, we present observations and analyses of mineral matter in coals obtained through use of electron microscopes. These data significantly increase our knowledge of the mineral matter in coals as related to their affects on coal combustion: syngenetic and epigenetic minerals can be observed and identified by electron microscopy in conjunction with energy dispersive x-ray analysis; submicron micerals that are not readily identified or observed by scanning electron microscopy are easily viewed by use of transmission electron microscopy; calcite appears to be relatively scarce as a syngenetic mineral whereas calcite is an important epigenetic mineral usually occurring as cleat deposits; important minor syngenetic mineral assemblages appear to be associated with detritus. These minerals probably contain the major portion of minor and trace elements in coal; most of the epigenetic minerals should be readily removed from the coal resulting in a probable reduction in fouling and slagging.

6748 **Differential flow rheometer.** Pouska, G.A. (Petro Spec Corp., Littleton, CO); Link, J.M. pp 138-142 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The presence of solid particles in a slurry makes the use of conventional viscometers difficult, if not impossible. Where the particles are very fine, good results are obtainable with the Contraves, Stormer, or Fann rotational devices. When the particles become slightly coarser, the Brookfield viscometer can still give good results, but most of the other rotational units are ruled out. The capillary viscometer is widely used for fluid measurements, but the small opening makes it unsuitable for slurries. Therefore, a larger diameter tube type viscometer, or rheometer has been utilized at the Colorado School of Mines Research Institute. Because the extrusion rheometer is, in essence, a miniature pipeline, the geometry is identical to pipeline flow. This similarity greatly simplifies the design calculations for a pipeline and provides higher confidence in scale-up calculations. This is particularly true with slurries that show nonideal behavior like wall slip or time dependency. The rheometer also has the advantage of a broader range of shear rates than is attainable in rotational viscometers. With multiple tube diameters, and lengths, the shear rate can be varied from 1.0 to 10^4 sec^{-1}. Errors resulting from temperature variations are minimized with the rheometer, due to the relatively large sample size. In summary, it seems that the rotational viscometer is better-suited as a screening device where numerous samples must be studied or where only comparative results are needed. The rheometer is better-suited where more precise data are needed, such as for engineering design studies.

0108 Waste Management

REFER ALSO TO CITATION(S) 6702, 6717, 6860, 6893, 6903, 6905, 6914, 6915, 6939, 7259, 7261, 7262, 7263, 7264, 7265, 7266, 7267, 7268, 7269, 7270, 7271, 7272, 7273, 7274, 7276, 8074, 8286

6749 **(BMFT-FB-T—82-108) Reconstruction and trial operation of the flue gas desulphurization plant Weiher II.** Igelbuescher, H.; Gresch, H.; Fischer, W.; Miersch, S.; Hofmann, F. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1982. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750967.

1. Present state of research: When producing industrial gypsum as the end product of flue gas cleaning of off gas of chloride-containing combustibles, another off-water problem arises as a result of withdrawal of chloride from the washing fluid. 2. Object of research: Testing the SHU-FGD process at the test plant Weiher II with increasing off-water chloride concentrations at optimal gypsum quality and minimal off-water quantity to be evaporized. 3. Result: The dewatering of the gypsum by centrifuges is feasible without problems with a calcium chloride content in the washing fluid up to 30% by weight. A residual humidity of $<=10\%$ by weight of free water has been obtained in nearly all test runs. 4. Conclusion: An optimal operation of the washing fluid with a calcium chloride content from 10 to maximally 20% by weight of $CaCl_2$ is feasible to reach the properties of quality required by the gypsum industry, namely $<=10\%$ H_2O and $<=0.01\%$ Cl.

6750 **(CONF-8105173—) Third seminar on the desulphurization of fuels and combustion gases.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1981. 855p. NTIS (US Sales Only), PC A99/MF A01. Order Number DE82905327.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

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At the invitation of the Government of Austria, the third Seminar on the Desulphurization of Fuels and Combustion Gases was convened from 18 to 22 May 1981 in Salzburg, Austria. At the invitation of the Government of the Federal Republic of Germany, a study tour was held in that country from 13 to 15 May 1981. The purpose of the Seminar was to provide a forum for an international exchange of recent experience and information on methods of prevention and abatement of SO_2 emissions and the disposal and utilization of by-products derived from desulphurization processes, as well as to discuss the cost of desulphurization. Sixty papers and four subject evaluations have been entered individually into EDB and ERA. (LTN)

6751 (CONF-8105173—, pp 21p, Paper 2) **Report of the seminar.** 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

From the information available, it is clear that the problem of air pollution, including long-range transboundary air pollution by sulfur compounds has recently commanded more attention than it received at the time of the last seminar. It is now generally recognized as an increasingly urgent problem demanding active preventive measures both on a national and international level with the objective of protecting low polluted areas and minimizing long range transmission of SO_2 and other major air pollutants. About 75 percent of the world's fuel consumption takes place in the ECE region which influences the emissions of SO/sub x/ and NO/sub x/ within the region. It has been estimated that two-thirds of global man-made SO_2 emissions originate in the ECE region. The ECE sulfur dioxide emissions in 1978 totalled almost 100 million tons, which was almost the same as for 1973. The limitation of the increases in emissions may be due to various factors, such as lower economic growth, energy conservation, changes in energy production and consumption patterns, stricter air pollution control measures and, above all, a wider application of best available technologies which are more economically feasible than five years ago. Since technologies to combat air pollution at the source are available and have been proven on a commercial scale, recent years have seen a breakthrough in public thinking on the subject. The shift to larger single sources of emissions, facilitates the planning and application of such technologies. In this situation, wide use of dispersion techniques is no longer advisable. Nearly every country in the ECE region has become involved in the desulphurization of fuels and combustion cases. Through the promotion of research and development projects many new technologies for desulphurization of natural gas, hard coal and oil, as well as FGD systems are in operation on a commercial scale.

6752 (CONF-8105173—, pp 7p, Paper 6) **Spray absorption: a new concept within flue gas desulphurization.** Andreasen, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Flue gas desulphurization by spray absorption is a new concept which has received much attention from the utility sector, particularly in the United States. It is essentially a dry process, eliminating the wet slurries and sludges produced in wet scrubbers and expected to boost system availability at a substantial reduction in operation and maintenance costs. The process is based on the spray drying technology which has been known and applied commercially for half a century within a variety of industries. Figure 1 is a schematic outline of a spray dryer absorber system. (SDA system). Flue gas containing sulphurous gases and particulate matter enters the absorber chamber in which an alkaline solution or slurry is atomized. The intimate contact between the hot gases and the absorbent provides optimum conditions for the transfer of heat and mass. Acid constituents in the flue gas, such as SO_2 and SO_3, react with the alkaline droplets, which are simultaneously transformed into a particulate dry product; the latter, together with fly ash, is separated and recovered from the flue gas in the absorber and a down-stream dust collector. As the mechanical performance of an SDA-system is, to a great extent, insensitive to the choice of absorbent, a variety of commercially available reagents can be used, for instance: lime, sode ash, magnesium-, and sodium hydroxide. Lime is, however, favored due to its accessibility and low cost. Besides, it has another advantage in that the spent absorbent is disposed of as calcium sulphite and sulphate, both chemicals being nearly insoluble in water. The overall water consumption of a SDA-system is about one half to one third of the quantity required for a comparable lime or limestone based wet scrubber.

6753 (CONF-8105173—, pp 9p, Paper 8) **Desulphurization plants with gypsum recovery process for power plants and steel works.** Remmers, K. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Worldwide, more than 40 desulphurization plants implementing the MHI-process have been erected and are operating satisfactorily. This process is appropriate for a multiple application, for example for the desulphurization of waste gases from coal- or oil-fired power plants, from sinter machines and chemical plants. When there is an automatic adjustment to changing loads, the desulphurization plants achieve a high separation efficiency with flue gases rich in SO_2 as well as with those lacking SO_2. In addition power consumption for flue-gas desulphurization is low due to the small pressure loss. As a result of the production of a usable by-product, no environmental problems are caused. All these factors contribute to the aim of a high degree of perfection of process, construction and operation.

6754 (CONF-8105173—, pp 8p, Paper 9) **New uses for sulphur.** Ecker, A.; Pass, F. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In order to satisfy the growing energy demand, increasing amounts of sour natural gas, crudes and coal with high sulphur content are being utilized. Fuels and stack gases must be desulphurized to meet environmental regulations. Therefore, recovered sulphur has become the major source of supply for the sulphur market and, in certain areas, sulphur is produced in excess of regional demands. To overcome this over-supply a search for new applications was started. The transformation of hydrogen sulphide or sulphur

into profitable chemicals is very interesting although chemical uses do not provide an outlet for large quantities of sulphur. Significant progress has been made in developing sulphur compositions suitable as construction material. Sulphur asphalt and sulphur concrete have now reached the threshold leading towards commercialization. The properties of sulphur asphalt are described and the different technologies are compared in the paper. The costs of sulphur asphalt paving material compares well with those of conventional asphalt and depends on the costs of mineral aggregate and binder. The more expensive the asphalt, the better the economics of sulphur asphalt. The various processes for manufacturing sulphur concrete differ in the process control equipment and the added plasticizer. Sulphur concrete displays certain advantages as compared with portland cement concrete. A particular advantage is the superior performance to corrosive environments. Sulphur coatings will increasingly gain acceptance in the construction industry. Other potential uses include impregnation of porous material with molten sulphur and foaming special sulphur compositions. The development of a cold press-mould technology for sulphur-based compositions as well as work on extension of plastics with lower cost sulphur are still in their early stages, but the results to date have been encouraging.

6755 (CONF-8105173—, pp 14p, Paper 10) **BF-process for flue-gas desulphurization and no-reduction.** Knoblauch, K.; Grochowski, H.; Muehlhaus, L. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Bergbau-Forschung has developed a process for dry purification of gases containing SO_2 concentrations of up to 0.4 percent by volume, and has been running this process since 1974 in a prototype plant which deals with a flue gas flow of 130,000 m³/h (stp). The process is based on adsorptive binding of SO_2 to carbonaceous adsorbents (activated char) in the temperature range of 110 to 150°C with subsequent thermal regeneration of the loaded activated char, producing an SO_2-enriched gas with an SO_2-concentration of 30 percent by volume. Simultaneously with the SO_2, chlorine and fluorine compounds are separated. By minor process modification, it is possible to separate at the same time - or disintegrate catalytically to N_2 and H_2O - a considerable portion of the NO-compounds. Starting from the basic process principle, the paper discusses the technical configuration of the process plant and the results obtained up to present during 14,000 hours of experimental operation. Subsequently, the possibility of scaling-up the individual process units as well as investment and utility costs is discussed.

6756 (CONF-8105173—, pp 23p, Paper 13) **Comparison of various methods to reduce sulphur in the air of the Helsinki metropolitan area.** Wallin, M.; Lumme, E.; Hietamaeki, M.; Rantakrans, E. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

This study aims at clarifying the present SO_2 problems, and their future development up to the year 1990, in the air of the Helsinki metropolitan area. The study consists of three parts: estimates of SO_2 emitted or expected in 1977 and 1990 in different, alternative situations; analysis of the resulting air quality using a dispersion model; and cost analysis. The conclusions are drawn on the bases of the comparison of emissions, air quality and costs found in the different alternatives. In the estimates of further development, the energy demand, the sulfur content of the fuels and the centralized combined heat and power production are expected to develop in a certain manner. The base estimate shows the development up to 1990, when no special air management measures will be used (district heating is not regarded as a separate pollution control measure in this context). In another alternative, estimates are based on a set of different possible measures including flue gas desulphurization, use of low-sulfur heavy fuel oil, use of low-sulfur light fuel oil, combined low-sulfur heavy and light fuel oil use and combined flue gas desulphurization and use of low-sulfur light fuel oil. The results show for example that although the emissions would double from 1977 to 1990 in the base alternative, the further centralized district heating with fewer but taller chimney stacks would lower remarkably the concentrations of SO_2 in the air. However this factor alone will not be effective enough and there would be rather high values especially in short-term ambient air concentrations. The best situation could be achieved in those alternatives where low-sulfur heavy fuel oil is used. Flue gas desulphurization would have less effect given the conditions. Also the differences in the costs of the alternatives seems quite clear. Flue gas desulphurization proves to be the most expensive alternative.

6757 (CONF-8105173—, pp 3p, Paper 16) **Alternative methods for flue gas desulphurization using the limestone method.** Gladky, A.V.; Brodsky, Yu.N. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Absorption methods for flue gas desulphurization without absorbent regeneration based on the use of natural limestone suspension have been developed and improved in the USSR in recent years. Two variants of the limestone method were tested at length at a pilot plant with a capacity of 30,000 m³ of gas per hour. The first variant involved two stages of gas and absorbent contact, with a different pH value of the absorbent at each stage. The absorbent contains, in addition to natural limestone, a liquid-phase catalyst, manganese sulphate. The process provides for 100 percent utilization of the limestone and the production as a by-product, of gypsum containing at least 90 percent basic substance. The use of the catalyst makes further oxidation by air of calcium sulphite in a special apparatus unnecessary. The second variant involves single-stage contact between the gas and the absorbent limestone suspension. In addition to limestone, the absorbent contains effective admixtures of organic acids. The experiments were conducted with the use of benzoic acid. The process provides for the further oxidation of the used suspension in a special reactor in the presence of a liquid-phase catalyst, manganese sulphate. It also produces gypsum and involves at least 90 percent utilization of natural limestone. The report presents the technical and economic calculations for flue gas desulphurization in a 500 MW thermal electric power plant burning coal according to the method recommended by ECE.

6758 (CONF-8105173—, pp 5p, Paper 22) **Quick sorbent quality evaluation procedure in the wet flue gas desulphurization process.** Janusz, S. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Selection of the proper kind of sorbent is a problem of utmost importance with the wet limestone flue-gas desulphurization method. The application of sorbent with suitable reactivity has a decisive effect upon the desulphurization efficiency and the process economy. A simple procedure and laboratory measuring set have been worked out allowing for the rapid comparative evaluation of the sorbents' reactivity with respect to sulfur dioxide for sorbents with different physico-chemical properties, kind and origin as well as granulation. Simple construction and uncomplicated measuring systems permit the evaluation of given sorbent applicability in a relatively short time (during a number of hours). The principle of the measuring set operation is based on passing the model gas mixture through a thermostated absorber bubbler filled with a given amount of sorbent water suspension, where the sulfur dioxide absorption takes place. In order to obtain comparable results it is necessary to carry out individual measurements for each sorbent in strictly controlled identical conditions. Two sorption efficiency evaluation criteria were used: total sulfur dioxide sorption capacity of a sorbent determined as an amount of sulfur dioxide absorbed in the course of the whole measurement up to the breakthrough point; the character of sulfur dioxide absorption dependence on the measurement duration time. Different kinds of natural sorbents were tested which might find application in the wet limestone scrubbing method, i.e. limestone, dolomite and chalk. The results obtained are illustrated using examples of some typical sorbents tested on the set. The test results have shown marked differences in individual sorbent reactivities, depending both on their chemical composition and on the kind and origin.

6759 (CONF-8105173—, pp 9p, Paper 23) **Operating experience with a wet limestone flue gas desulphurization installation.** Pinko, L.; Janusz, S. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The Power Research and Testing Establishment Energopomiar is involved in a long-term research programme related to the wet limestone flue-gas desulphurization method. The principle of the method is based on the absorption of sulfur dioxide in a water suspension of finely pulverized limestone. A three-bed turbulent contact absorber is used as a scrubber (a scrubber filled with moving hollow plastic spheres). In order to verify the method on a larger scale before putting it into practice and wide application, an experimental installation of 50,000 m^3 flue gas per hour capacity has been built at one power plant. The installation desulphurizes part of flue gas from a boiler burning bituminous coal. Flue gas inlet into the installation is located after the electrostatic precipitator. The flue gas contains 0.15 percent by volume sulfur dioxide and up to 0.4 g/m^3 dust. The installation's operation is conducted in accordance with a predetermined research programme in order to perform technological and constructional optimization, cost minimization and verification of reliability. Desulphurization efficiency above 85 percent was obtained at operational parameters corresponding to real industrial conditions. The results obtained so far during the operation have demonstrated the correctness of the technological design solutions and above all the applicability of the turbulent contact absorber. The test results from the experimental operation will provide data necessary for working out of the design specification for a full-scale industrial installation for typical coal burning power units. The method can find application in gas cleaning in other industries also. The estimated capital investment and annualized costs of the method for a 100 MW power unit are $6.1 million and $2.1 million, respectively.

6760 (CONF-8105173—, pp 10p, Paper 24) **Operating experience with the flue gas desulphurizer system of Scholven** F. Gutberlet, H. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The 740 MW hard-coal unit Scholven F has been provided with a flue-gas desulphurizer system for presently handling 625,000 Nm^3/h which corresponds to a quarter of the flue-gas quantity. Two other lines with the same capacity are under construction. The flue-gas desulphurizer works according to a method developed by the Japanese licenser, Mitsubishi Heavy Industries, and is distributed in the Federal Republic of Germany by Thyssen Engineering. It refers to a wet flue-gas scrubbing process using lime with gypsum as a useful end product. To cool the flue gas down to 52°C the SO_3 absorber is preceded by a cooler. This combination of separate flue-gas cooler and absorber in a scrubbing tower is a peculiarity of the process and leads to high-quality gypsum. The flue gas is cooled by evaporating water from the cooling tower basin; thus it is freed from impurities such as fly ash and hydrogen halides before SO_3 is absorbed. In the absorber, a suspension of calcium sulphite is formed which, by a subsequent oxidation, is converted into calcium sulphate. In a separate gypsum station, centrifuging of the suspension produces the gypsum which lends itself to further processing. The cleaned flue gas enters the stack without reheating. The waste water arising in the cooler circuit and from the thickener overflow must be treated in a separate step. Neutralization and precipitation of gypsum and metal hydroxides is done with lime milk.

6761 (CONF-8105173—, pp 25p, Paper 28) **Flue gas desulphurization costs applicable to Canadian utilities.** 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

This discussion paper outlines the problems encountered and the methods employed to take an existing United States flue gas desulphurization cost control model (Tennessee Valley Authority) and apply it to new and existing Canadian utilities in order to arrive at meaningful costs adjustments to reflect Canadian conditions, different plant capacity factors, different sulfur emission control standards, different fuels, etc. The parameters for a Base Case Limestone Slurry FGD Cost Model for a 500 MW unit located in Toronto utilizing 3.5 percent sulfur, 10,500 Btu per pound coal are outlined. Capital costs show a total depreciable investment of $50.8 million, or $101.63 per kilowatt. Total annual operating costs for 7000 hours of operation are $15 million, or 4.27 mills per kWh. These costs are evenly divided between direct and indirect items. For cost comparison purposes, the FGD control cost figures for a 100 MW and a 500 MW unit - both oil - and coal-fired according to the operating characteristics outlined in the Guidelines for Presentation of Cost Data for the Third Seminar on Desulphurization of Fuels and Combustion Gases - are discussed. It is apparent that total FGD operating costs per kWh will tend to increase sharply as plant capacity factors are reduced, i.e. a Base Case plant operating only 3500 hours per year would cost 7.14 mills per kWh (67 percent more than the Base Case operation), if all of the control related annual costs were unchanged while the remaining annual costs were reduced directly in proportion to the reduced operating hours.

6762 (CONF-8105173—, pp 10p, Paper 32) **Operating properties of the Walther-ammonium sulphate process with special reference to indirect reheating without use of external heat.** Bechthold, H.; Fischer, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The WALTHER-process for flue-gas desulphurization uses ammonia to produce pelletized ammonium sulphate which, in this form, can be directly applied as a fertilizer. Compared to the commercial crystalline quality, it offers the advantage of having the same spreading properties as any granulated fertilizer. The granulation may be adjusted within a wide range. There are numerous further advantages to the process in addition to the production of a directly usable end-product. Among these are: no waste water whatsoever; the cleaned gases can be reheated without any heat from external sources; no danger of incrustation due to the use of clear scrubbing solutions; and high adaptability to extreme fluctuations of load in the power station operation.

6763 (CONF-8105173—, pp 8p, Paper 37) **High grade purification of lean sulphurous combustion gas.** 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Boliden has had lengthy and diversified experience manufacturing sulphuric acid and cleaning vast volumes of sulphurous gases. Due to strict regulations for environmental protection in Sweden, Boliden has been forced to develop and operate a number of processes to meet the requirements set by the authorities. The process described in the paper is a combination of several processes particularly suitable for large volumes of gas with low contents of sulfur components, such as combustion gases from coal-fired power plants. The product derived is a concentrated sulphuric acid, thus avoiding wastes to be disposed of. The process concept is characterized by the following main process steps: catalytic conversion, absorption of the SO_3 formed, oxidation of the remaining SO_2 by nitrogen oxides as catalyst, absorption of NO_2 and formation of nitric acid, scrubbing of tail-gas with condensate formed for elimination of F, Cl, Hg, As, etc., and separation of sulphuric acid mist. The paper also gives estimated figures regarding investments and operation cost.

6764 (CONF-8105173—, pp 7p, Paper 39) **CGA/ALCATEL process of flue-gas desulphurization with sulphuric acid as a by-product.** Carrive, F.; Salauen;. 1981. (In French). NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In the CGA/ALCATEL process, sulfur dioxide contained in flue gases is oxidized into sulphuric acid through the action of a dissolved catalyst. The solution is concentrated by the heat of the gases: 75 percent of the sulphuric acid obtained can be utilized, particularly in the manufacture of phosphorus fertilizer. The process is applied to flue gases with a minimum temperature of 130 to 180°C, depending on the concentration of sulfur dioxide in the gas. The desulphurization yield is over 99 percent. The rate of removal of solid particles is almost 100 percent. A desulphurization unit has been in service for the past four years on a 3 MW boiler fired with heavy fuel oil containing 4 percent sulfur. The energy consumption of the CGA/ALCATEL system depends on the sulfur content of

the fuel and amounts to between 1.7 and 5 percent (in the case of sulfur content of 6 percent) of the energy produced by the boiler.

6765 (CONF-8105173—, pp 6p, Paper 43) **Desulphurization of exhaust gases in chemical processes.** Asperger, K.; Wischnewski, W. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The sulfur content of exhaust gases can be reduced by: desulphurization of fuels; modification of processes; or treatment of resultant gases. In this paper a few selected examples from the chemical industry in the German Democratic Republic are presented. Using modified processes and treating the resultant gases, the sulphuric content of exhaust gases is effectively reduced. Methods to reduce the sulfur content of exhaust gases are described in the field of production of: sulphuric acid; viscose; fertilizers; and paraffin.

6766 (CONF-8105173—, pp 11p, Paper 49) **Survey of processes for the removal of NO/sub x/ and the simultaneous removal of SO_2 and NO/sub x/ from the flue gases of industrial boilers.** Rentz, O.; Hempelmann, R. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The paper reviews the state of the art of technologies for the removal of NO/sub x/ from the waste gases of industrial boilers, especially power plants. The essential possibilities of a NO/sub x/-control are discussed referring especially to Japanese developments of such processes. In the flue gases of industrial boilers generally there are further pollutants which eventually have to be removed, e.g. SO_2 and fumes. Therefore the problem of the design of an abatement system for all these components is touched upon. The fundamental chemical engineering principles of the most important processes for NO/sub x/-control as well as their advantages are dealt with in detail. The process types included are: wet processes for simultaneous removal of NO/sub x/ and SO_2 (absorption/reduction processes and oxidation/reduction processes); and dry processes (selective catalytic reduction (SCR) processes and dry processes for the simultaneous removal of NO/sub x/ and SO_2). Finally, a comparison is made between the different process types with regard to technical and ecological criteria. Data for the investment and the operating cost incurred by the application of NO/sub x/ removal technologies are also given.

6767 (CONF-8105173—, pp 8p, Paper 52) **Experience with the Bischoff FGD-process in the NWK power station Wilhelmshaven.** Kleeberg, U.; Leimkuehler, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The first commercial flue gas desulphurization (FGD) plant was commissioned in 1977 at the 720 MW Wilhelmshaven power station of the Nordwestdeutsche Kraftwerke, to demonstrate the applicability of the process on large scale. This plant, designed to treat 500,000 m³/sub n//h of flue gas was built by Gottfried Bischoff GmbH and Company KG in Essen. Since the time of start-up, the plant has been improved and adapted to the requirements of power plant operation. Experimental runs of the plant were made to gain further experience for the design of other FGD plants. The investigations included the following items: long-term behavior of materials; reduction of running costs; minimizing of plant equipment; mist elimination and gas reheat; test of different absorption materials; and production of gypsum. The experience gathered from the investigations had a strong influence on the design and construction of the second FGD plant in the same power station which was ordered in February 1980 and is now under construction. This plant was designed to treat 1,300,000 m³/sub n//h flue gas (approximately 400 MW) producing gypsum. The plant is expected to be commissioned in early 1982.

6768 (CONF-8105173—, pp 6p, Paper 58) **Some new developments in combined SO/sub x/ and NO/sub x/ removal from flue gases and separation of pyritic sulphur from solid fuel at thermal power stations.** Gavrilov, A.F.; Chmovzh, V.E. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

A description is given of a process for the removal of oxides of sulfur and nitrogen from thermal power station flue gases by further oxidation of the lower oxides and their conversion to higher oxides that are highly soluble in water. A feature of the process is the simultaneous removal of oxides of sulfur and nitrogen. The other process is for the separation of pyritic sulfur (iron pyrites) from the solid fuel of a thermal power station, its combustion and SO_2 removal from the combustion products. This process has a number of operational and economic advantages; the volume of flue gases for treatment is reduced by a factor of 40 to 50.

6769 (CONF-8105173—, pp 23p, Paper 64) **Flue gas cleaning waste management in the United States.** Jones, J.W.; Santhanam, C.J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

As the United States turns to coal as the primary fossil fuel, coal utilization in industrial and utility boilers is expected to increase dramatically. Consequently, generation of coal ash (fly ash and bottom ash) and flue gas desulphurization (FGD) wastes, which jointly can be referred to as flue gas cleaning (FGC) wastes, is expected to increase over the next 20 years. Most of the FGC wastes generated in the United States will be disposed of, rather than utilized. These wastes represent significant potential sources of environmental pollution unless proper disposal technology is employed. Continuing research and development efforts sponsored by governmental organizations including the United States Environmental Protection Agency (EPA) and the United States Department of Energy (DOE), as well as efforts in private industry in recent years have provided substantial information on: environmentally sound disposal techniques, economic impact of such disposal, and major issues concerning utilization of such wastes. The paper presents a brief account of FGC waste management in the United States including: generation trends in FGC wastes, chemical/physical characteristics, disposal practices, economics of disposal, and utilization options.

6770 (DOE/LC/10440—T1) **Site visit report: Pennsylvania Electric Company Keystone Generating Station, Shelocta, Pennsylvania. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 74p. NTIS, PC A04/MF A01. Order Number DE83003765.

Portions of document are illegible.

This report details the activities, facilities, and equipment used to sample raw feedstock and waste solids at Pennsylvania Electric Company's Keystone Generating Station. Explanation of sampling locations, deviations from the test plan, sampling techniques (in accordance with the Fossil Energy Waste General Sampling Guideline), and plant design are reviewed.

6771 (DOE/LC/10440—T5) **Site visit report: Southwestern Electric Power Company Welsh Plant, Pittsburg, Texas. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 75p. NTIS, PC A04/MF A01. Order Number DE83003740.

Portions of document are illegible.

This report details the activities, facilities, and equipment used to sample raw coal feedstock and waste solids at the Southwestern Electric Power Company's Welsh Plant in Pittsburg, Texas. Explanation of sampling locations, deviations from the Test Plan, sampling techniques (in accordance with the Fossil Energy Waste General Sampling Guideline), and plant design are reviewed.

6772 (DOE/LC/10440—T8) **Site visit report: Kansas City Power & Light Company Montrose Plant, Clinton, Missouri. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 62p. NTIS, PC A04/MF A01. Order Number DE83003402.

Portions of document are illegible.

This report details the activities, facilities, and equipment used to sample raw feedstock and waste solids at the Kansas City Power & Light's Montrose Plant in Clinton, Missouri. Explanation of sampling locations, deviations from the test plan, sampling tech-

niques (in accordance with the Fossil Energy Waste General Sampling Guideline), and plant design are reviewed.

6773 **(DOE/LC/10440—T13) Site visit report: Georgetown University fluidized-bed combustor, Washington, DC. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 61p. NTIS, PC A04/MF A01. Order Number DE83003690.

This Site Visit Report describes the procedures used to collect samples of coal, limestone, and combined waste (fly ash and spent bed material) from the fluidized bed boiler at Georgetown University's Steam Generating Plant in Washington, DC. A layout of the plant, including its feed and waste material handling systems is provided. A discussion of the plant's materials handling procedures leads to the development of the sampling schedule used to ensure that the waste sampled was that generated from the sampled lots of feedstocks. Also included is a description of the procedures used to process, containerize, and label each sample type.

6774 **(DOE/LC/10440—T16) Site visit report: Henderson Municipal Light Company/Big Rivers Electric Corporation Robert Reid Power Station, Henderson, Kentucky. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 61p. NTIS, PC A04/MF A01. Order Number DE83003691.

This report details the activities performed and equipment used to sample coal feedstock and solid wastes at the Robert Reid Power Station in Henderson, Kentucky. The plant is operated and co-owned by Big Rivers Electric (operator) and Henderson Municipal Light Corporation. Sampling locations and techniques (selected in accordance with the Fossil Energy Waste General Sampling Guidelines), plant design, and processing activities are discussed.

6775 **(DOE/LC/10440—T18) Site visit report: Kansas City Power and Light Company La Cygne Generating Station, La Cygne, Kansas. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 83p. NTIS, PC A05/MF A01. Order Number DE83003767.

Portions of document are illegible.

This report details the activities, facilities, and equipment used to sample raw coal feedstock and waste solids at Kansas City Power and Light Company's La Cygne Generating Station. Explanation of sampling locations, deviations from the test plan, sampling techniques (in accordance with the Fossil Energy Waste General Sampling Guideline), and plant design are reviewed.

6776 **(DOE/LC/10440—T19) Site visit report: Southern California Edison Company Mohave Plant, Laughlin, Nevada. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 62p. NTIS, PC A04/MF A01. Order Number DE83003703.

This report details the activities, facilities, and equipment used to sample raw coal feedstock and waste solids at the Mohave Plant located in Laughlin, Nevada. Explanation of sampling locations, deviations from the Test Plan, sampling techniques (in accordance with the Fossil Energy Waste General Sampling Guideline), and plant design are reviewed.

6777 **(DOE/LC/10440—T20) Site visit report: Wisconsin Power and Light Columbia Power Station, Portage, Wisconsin. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 63p. NTIS, PC A04/MF A01. Order Number DE83003741.

This report details the activities, facilities, and equipment used to sample raw coal feedstock and waste solids at the Wisconsin Power and Light Company's Columbia Power Station. Explanation of sampling locations, deviations from the Test Plan, sampling techniques (in accordance with the Fossil Energy Waste General Sampling Guideline), and plant design are reviewed.

6778 **(DOE/LC/10440—T21) Site visit report: Tennessee Valley Authority John Sevier Power Plant, Rogersville, Tennessee. Final report.** (Versar, Inc., Springfield, VA (USA)). [nd]. Contract AC20-80LC10440. 60p. NTIS, PC A04/MF A01. Order Number DE83003694.

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This report details the activities, facilities, and equipment used to sample raw feedstock and waste solids at Tennessee Valley Authority's John Sevier Steam Plant. Explanation of sampling locations, deviations from the test plan, sampling techniques (in accordance with the Fossil Energy Waste General Sampling Guideline) and plant design are reviewed.

6779 **(DOE/METC—82-52-Vol.1) Challenge of change: sixth international ash-utilization symposium proceedings.** Halow, J.S.; Covey, J.N. (eds.). (USDOE Morgantown Energy Technology Center, WV; National Ash Association, Washington, DC (USA)). Jul 1982. 495p. (CONF-820333—Vol.1). NTIS, PC A21/MF A01. Order Number DE83000578.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Portions of document are illegible. Printed copy available until stock is exhausted.

This symposium dealt with the methods of utilizing or disposing of fly ash, bottom ash, and desulfurization sludges produced by the combustion of coal for power generation. The pozzolanic nature of fly ash makes it a good material for use in concretes, highway construction and maintenance, and as a stabilizer for industrial waste disposal. Other uses are mentioned as well. Quality control procedures and chemical composition of fly ashes are also included. Separate abstracts were prepared for the individual papers. (CKK)

6760 (DOE/METC—82-52-Vol.1, pp 5-14) **Use of fly ash in highway construction Demonstration Project No. 59: Federal Highway Administration Demonstration Projects Division.** Sommerfeld, J.C. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

To meet the need for analyzing and implementing research results on the use of fly ash, the Federal Highway Administration established Demonstration Project 59. This project is designed to train public officials in proper quality control procedures for utilizing fly ash. The quality, characteristics, composition, and pozzolanic classification are discussed for fly ash as a material for highway construction. The mixing process, placement, quality control, and the autogenous healing properties of fly ash are discussed for its use as a roadbase material. The use of fly ash as a substitute for cement in concrete is also described. The variability of fly ash results from the type of coal and efficiency of combustion of the coal. This variability must be known and planned for in any successful application of fly ash.

6761 (DOE/METC—82-52-Vol.1, pp 15-36) **Cements from slags and fly ash.** Bijen, J. (Intron Inst., Maastricht, Netherlands). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

An examination has been carried out into cements made of 60% finely ground hydraulic slag and 40% fly ash, with a few percent of activator added. Blast furnace slag as well as hydraulic slag synthetized in the laboratory were used. The latter was made from, among other substances, fly ash. The composition and preparation of this synthetic slag were such that optimum hydraulic properties could be expected. The slag was ground to a fineness with 80% < 20 μ. The activators used were: alkaline solutions, alkaline substances added dry, and ground portland clinker with gypsum/anhydrite. Of the cements obtained some met the standard requirements for ordinary portland and blast furnace cements concerning strength development. The synthetic slag has neither economic nor technical advantages compared with blast furnace slag with a high hydraulicity.

6762 (DOE/METC—82-52-Vol.1, pp 37-56) **Sulfate resistance of mortars using fly ash as a partial replacement for Portland Cement.** Rosner, J.C.; Chehovits, J.G.; Warburton, R.G. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

This project compared the sulfate resistance of mortars containing fly ash as a partial cement replacement with control mortars

that do not contain fly ash. Fly ash from four different sources and at three different replacements, 10%, 15%, and 20%, by weight of cement, were evaluated. Three of the fly ashes satisfied ASTM C618 Class F standard specifications and the fourth fly ash met all requirements for Class C. A single portland cement source, meeting ASTM Type II specifications was used. The test procedure followed a method recently developed by K. Mather at the Waterways Experiment Station, US Army Corps of Engineers. One by one by eleven inch mortar bars were subjected to a mixed (sodium and magnesium) sulfate solution environment. Physical measurement of mortar bars included length change, weight change, porosity and relative dynamic modulus. Measurements were made for 360 days of immersion. Test results indicate that the mortar bars which do not contain fly ash reached the test procedure failure criteria for linear expansion at between 300 and 360 days of immersion. Bars containing three of the fly ashes investigated had not failed as indicated by linear expansion after 360 days of immersion in the sulfate solution. Average expansion for mortar bars containing the three ashes was one-fourth that of the control bars. For the three successful ashes, ash percentage did not influence results. Mortar bars containing the fourth ash at a 10% replacement failed as indicated by length change while those at 15 and 20% replacements did not.

6783 (DOE/METC—82-52-Vol.1, pp 57-78) **Fly ash as a mineral filler and anti-strip agent for asphalt concrete.** Rosner, J.C.; Chehovits, J.G.; Morris, G.R. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

This project studied the effectiveness of fly ash as a replacement for Portland Cement and hydrated lime in production of asphalt concrete mixtures. Both mixture design and moisture resistance characteristics were studied. Properties of asphalt concrete containing additions of two different fly ashes at 1, 3, and 6% and four combinations of cement, lime, and fly ash were compared to those of mixtures containing only natural fines, a chemical anti-strip, 2% hydrated lime, and 2% portland cement. Results indicate that with respect to Marshall mixture design criteria, acceptable asphalt concrete mixtures can be produced in the laboratory with up to 6% fly ash by weight of aggregate. Asphalt concrete mixtures containing up to 6% fly ash had lower voids in mineral aggregate and asphalt requirements than conventional mixtures. Analysis of data generated during immersion-compression testing indicates that fly ashes investigated in this study can improve moisture resistance characteristics of asphalt concrete mixtures. Several of the fly ash additions investigated were found to be as effective for improving moisture resistance as chemical anti-strip, portland cement, and hydrated lime.

6784 (DOE/METC—82-52-Vol.1, pp 79-101) **Evaluation of plant growth and chemical properties of mine soils following application of fly ash and organic waste materials.** Singh, R.N.; Keefer, R.F.; Ghazi, H.E.; Horvath, D.J. (West Virginia Univ., Morgantown). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

In 1977, experiments were established at three different mine soil locations which had remained barren in spite of several attempts to revegetate them. These areas had been limed, fertilized, and seeded with no success. It was postulated that application of fly ash along with sewage sludge and animal manure would improve the physical and chemical properties of the mine soils to such an extent that deep-rooted legumes could be established. These legumes would require no supplemental nitrogen and hence could grow for a long time with no further maintenance. Thus, seed of alfalfa (Medicago sativa) and Sericea lespedeza were inoculated with N-fixing bacteria and planted in replicated plots which had received measured amounts in a factorial combination of fly ash, sewage sludge, and chicken manure. Plots which received a combination of fly ash, sewage sludge, and chicken manure after four years showed the best stand of lespedeza. However, alfalfa was replaced by grass on the plots probably due to intensive grazing by deer. Residues of fly ash, sewage sludge, and chicken manure on the plots affected plant growth and composition and altered the chemical properties of the mine soils.

6785 (DOE/METC—82-52-Vol.1, pp 102-118) **Coal-fired power plant wastes for ocean reef construction.** Duedall, I.W.; Woodhead, P.M.J.; Parker, J.H.; Carleton, H.R. (State Univ. of New York, Stony Brook). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

A multidisciplinary team at SUNY, Stony Brook, is assessing the feasibility of using blocks of waste material from coal-fired power plants for underwater construction, including building artificial fishing reefs. Experiments over the past five years, both in the laboratory and in the sea, suggest that coal waste blocks may be environmentally acceptable in the ocean. On September 12, 1980, a 500 ton reef was constructed in the Atlantic, consisting of 15,000 solid blocks 8 in. x 8 in. x 16 in. of stabilized FGD (flue gas desulfurization) sludge and fly ash from coal burning power plants. The blocks were fabricated in collaboration with IU Conversion Systems, Inc. (Horsham, Pennsylvania) at a commercial concrete block plant. The ratio (dry weight) of fly ash to FGD sludge in the blocks was about 1.5:1 and 3:1 for two different mixes used. In the preparation of block fabrication, a combination of different coal waste mixes, stabilization additives, and curing procedures were screened to develop candidate mix designs. Experiments were made at research facilities of the Besser Company in Alpena, Michigan to develop methods of successfully forming coal waste blocks with block making machines. The demonstration disposal ref will be monitored for three to four years to assess environmental impacts which may occur and to measure the development of the biological communities which will be associated with the reef.

6786 (DOE/METC—82-52-Vol.1, pp 119-127) **Self hardening fly ash.** Thornton, S.I.; Parker, D.G. (Univ of Arkansas, Fayetteville). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Fly ash produced in Arkansas from burning Wyoming low sulfur subbituminous coal is self hardening and can be effective as a soil stabilizing agent for clays and sands. Stabilization is best in sands and clay because of better mechanical interlock with soil particles. The strength of soil-self hardening fly ash develops rapidly when compacted immediately after mixing. Seven day unconfined compressive strengths up to 1800 psi (12,400 kN/m^2) were obtained from 20% fly ash, 80% sand mixtures. A time delay between mixing the fly ash with the soil and compaction of the mixture reduced the strength. With two hours delay, over a third of the strength was lost and with four hours delay, the loss was over half. Gypsum and some commercial concrete retarders were effective in reducing the detrimental effect of delayed compaction. Based on field tests at SWEPCO's Flint Creek power plant, adequate mixing and rapid compaction were found to be necessary in construction of stabilized bases.

6787 (DOE/METC—82-52-Vol.1, pp 128-136) **Successful application of the use of fly ash in specification air-entrained concrete.** Martin, R.; Hilton, R.G. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Early in 1980, construction of a relatively large facility located to the north of Cincinnati, Ohio, was commenced. This project required production of approximately 60,000 cu. yds. of concrete over an eighteen month period. All the concrete incorporated Class F fly ash meeting the requirements of ASTM C618. This paper discusses the performance of closely inspected concrete, air entrained and incorporating fly ash, which is batched at an off-site plant and mixed and delivered by truck mixer. Test data has been documented for nearly 18 months and variability of the following concrete properties is analyzed: strength at 7 and 28 days, cylinder weight at 7 days, air content, slump, concrete temperature and time between sampling and leaving plant.

6788 (DOE/METC—82-52-Vol.1, pp 137-163) **Coal refuse-fly ash mixtures as a base course material.** Anderson, R.B. (GAI Consultants, Inc., Pittsburgh, PA); DiGioia, A.M. Jr.; Head, W.J. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

A potential use of coal refuse is highway base course construction. Frequently, coal refuse lacks fines, and the addition of fine-grained materials is needed to produce mixtures with high mechanical stability. An excellent candidate for the fine-grained additive is fly ash. This paper outlines the findings of a study performed for the Federal Highway Administration by GAI Consultants, Inc., and West Virginia University of the potential use of mixtures of coal refuse and fly ash as highway base course materials. It identifies potential market areas in which the use of such mixtures would be highly favorable from economic, environmental, and material availability perspectives. It presents the results of an extensive laboratory testing program which dealt with the physical and engineering properties of mixtures of coal refuse and fly ash samples extracted from disposal sites in the potential market areas. A comparison of serviceability indices and physical damage parameters based on the VESYS Predictive Design Procedure between a crushed stone and coal refuse-fly ash blends is also presented for several hypothetical pavements. These findings indicate that substituting stabilized coal refuse-fly ash mixtures in place of conventional base course material is technically and economically feasible. The paper also includes procedures for developing design mixtures of cement or lime stabilized coal refuse and fly ash and presents procedures for, and an example of, pavement design as outlined in the National Ash Association guide for the Design and Construction of Cement Stabilized Fly Ash Pavements.

6789 (DOE/METC—82-52-Vol.1, pp 164-189) **Utilization of Class C fly ash in concrete.** Smith, R.L. (Raba-Kistner Consultants, Inc., San antonio, TX); Raba, C.F. Jr.; Mearing, M.A. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

The utilization of Class F fly ash as a mineral admixture in portland cement concrete has been well established. Class C fly ash, in comparison, has only recently experienced widespread use as a concrete admixture. Although its utilization in concrete products has experienced considerable success in the field, only a limited amount of information on Class C fly ash has been made available to engineers, ready mix producers and contractors. This paper discusses in detail the utilization of one Class C fly ash in concrete. The Class C fly ash is produced at the J.T. Deely plant near San Antonio. The power plants use Wyoming subbituminous coal as fuel and the resulting fly ash possesses sufficient calcium oxide to harden in the presence of water. Data are preented on the effect of the fly ash content and mixing temperatures on the engineering properties of plastic and hardened concrete.

6790 (DOE/METC—82-52-Vol.1, pp 190-198) **P.F.A.: a unique industrial filler.** Dower, J.E. (Filtec Ltd., Cheshire, England); Lindahl, D.K. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Pulverized fuel ash (p.f.a.) is composed of fly ash (75%), bottom ash (25%), and cenospheres (1 to 2%). Most fly ash and bottom ash is disposed of in lagoons, and from this disposal method has arisen the third fraction, the cenospheres. These are hollow spheres, typically in the 40 to 300 micron range, which float to the top of the lagoon and accumulate. The removal and disposal of floaters is relatively expensive, but they are now recognized as a valuable commodity. This paper examines some of the potential added value markets for this p.f.a. fraction and discusses some of the impediments which have prevented the exploitation of p.f.a. fractions.

6791 (DOE/METC—82-52-Vol.1, pp 199-213) **Critical look at ASTM C618 and C311.** Butler, W.B. (Monier Resources, Sydney, Australia). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

ASTM C618 is probably the most demanding specification for fly ash in the English speaking world, with comprehensive provisions for both chemical and physical tests. However, the time delays involved and the cost of testing are often out of proportion to the benefits derived. ASTM C311 does a creditable job of defining test methods to meet the needs of C618 but neither document makes any attempt to grade testing frequencies for individual tests in a practical manner. With the new ASTM committtee C 09.03.10 beginning the task of revising the documents, this paper takes a critical look at the status quo and presents recommendations for changes.

6792 (DOE/METC—82-52-Vol.1, pp 214-234) **Role of fly ash in co-utilization of industrial waste.** Minnick, L.J. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Large quantities of industrial waste materials can be blended with fly ash to develop compositions for use in constuction and other secondary applications of the recovered materials. The paper describes current applications using mixtures of fly ash and SO/sub x/ scrubber sludge, and acid treatment waste sludges from treatment of acidic industrial waste. More particularly, information is presented dealing with compositions utilizing cement and limekiln dusts; also residuals from fluidized combustion boilers. These mixtures are finding uses in structural paving, in the production of synthetic aggregates, and as an expansive grout for mine plugging. Fly ash represents the major constituent in these products. All of the processes utilize cementitious type fly ash reactions at ambient temperature (requiring no significant energy input). In addition to developing ultimate physical properties, the chemical reactions serve as a mechanism to reduce or eliminate undesirable leaching of toxic ions to the environment.

6793 (DOE/METC—82-52-Vol.1, pp 235-245) **Review of American and foreign specifications for use of fly ash in Portland Cement concrete.** Manz, O.E. (Univ. of North Dakota, Grand Forks). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

There are several federal and state specifications being used in the United States involving the use of fly ash in Portland Cement concrete. However, several foreign countries have separate specifications adopted for use by all agencies in the particular country. In the United States, the classification of fly ash by reference to the type of coal has been questioned, as well as some of the specification limits. The many new Western fly ashes have caused concern for some properties not presently covered, such as free lime and sulfate resistance. A review of the various specifications is presented, and included is a discussion of the similarities as well as items that are unique to a particular specification. An attempt is made to present a universal specification scheme for fly ashes.

6794 (DOE/METC—82-52-Vol.1, pp 246-258) **Answers to the objections to the use of fly ash in concrete.** Ashby, J.B. (Pozzolanic Inc., Cincinnati, OH). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

There have been any number of reasons given by specifiers for not allowing the use of fly ash in concrete covered by their specifications, by concrete producers for not using fly ash in their product and by other groups and individuals not allowing the use of fly ash in concrete over which they have the say on what ingredients are used. Some of the reasons advanced are based on technical grounds, some on ignorance, some on the economics and some on what is basically traditional belief amounting almost to folk-lore. Often it is not a real reason at all, but the result of lethargy or just resistance to change. This paper critically reviews those reasons (or excuses) that are most frequently used and presents a realistic look at the facts.

6795 (DOE/METC—82-52-Vol.1, pp 259-267) **Utilization of coal ash produced by electric power plants in Japan.** Tamanuki, S. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Faced with the projected large increase in the use of coal for power generation and the resulting large quantities of coal ash, Japan is seeking technologies that will permit diversification of the means of utilizing and disposing of ash. This paper discusses the

types and status of the technology of coal ash utilization in Japan. Mentioned is its use in cements, concretes, light-weight aggregates, road base materials, land reclamation, and a new use as a component in a new type of fertilizer.

6796 (DOE/METC—82-52-Vol.1, pp 268-277) **Simple test for evaluation of quality of fly ashes and other pozzolans for use in the cement and concrete industry.** Mehta, P.K. (Univ. of California, Berkeley). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

The chemical tests for evaluating the quality of fly ash and other pozzolanic materials are reviewed. By determination of the acid and alkali soluble constituents present in a pozzolan, it is possible to assess the lime fixation capacity of the material, however, this does not always provide a good correlation with the strength and durability-improving ability of the pozzolan, which should be the real measure of quality for use of the material in the cement and concrete industry. This is because the performance characteristics of a pozzolan in concrete are affected not only by the lime-pozzolan reaction, but also by the morphology and density of the reaction products, and pore-size distribution of the hardened cement paste. Since there is a direct relationship between the volume of large pores present in hardened cement paste and its strength or permeability, the pore-size distribution analysis of hydrated portland-pozzolan cement pastes offers an interesting approach for a direct evaluation of the quality of the pozzolan present. Such analysis involves the use of complex techniques, however, the volume of large pores may be indirectly ascertained by a simple test based on measurement of water penetration rate through a hydrated paste or mortar made with portland cement-pozzolan mixtures. In this paper, results of an investigation are described in which the quality of four fly ashes, two natural pozzolans, and two condensed silica-fume samples were evaluated by the water-penetration test.

6797 (DOE/METC—82-52-Vol.1, pp 282-293) **Use of fly ash in no-slump roller compacted concrete (RCC).** Saucier, K.L. (Waterways Experiment Station, Vicksburg, MS). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

No-slump concrete is an extremely dry concrete containing the minimum amount of water necessary for it to be leveled by a bulldozer and consolidated by a vibrating roller. Previous studies have demonstrated the feasibility of no-slump concrete for massive sections, and core specimens have indicated that density and strength properties were the equal of conventionally placed mass concrete. The tests reported in this paper were conducted to optimize mixtures for application to the roller-compacted concrete (RCC) techniques, to determine methods of improving hardened lift joints, and to discover economical methods of obtaining smooth surfaces at the boundaries of the RCC. A curb concept was found to be a viable method for obtaining smooth boundaries and mixtures with large amounts of fly ash (75% by volume) were found to be very adaptable to the RCC concept. (CKK)

6798 (DOE/METC—82-52-Vol.1, pp 294-313) **Controlling the effect of carbon in flyash on air entrainment.** Burns, J.S. (Genstar Corp., Vancouver); Guarnaschelli, C.; McAskill, N. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

The carbon content of fly ash has restricted its use in concretes requiring air-entrainment properties because the carbon is in the activated form and adsorbs the air-entrainment agents normally added to concrete mixtures. This paper reports the results of a study undertaken to examine the physical and chemical properties of activated carbon, to find chemicals to deactivate the carbon with respect to normally used air-entrainment agents, and to find alternative air-entrainment agents immune to the effects of carbon in fly ash. The solution to the air-entrainment problems appears to be in the addition of surface active agents capable of reacting with the carbon during the intergrind or blending of cements. (CKK)

6799 (DOE/METC—82-52-Vol.1, pp 314-357) **Engineering evaluation of blended coal by-product materials for stabilized base and highway construction applications.** Rosel, J.G.; Lin, C.; Lowe, J.A. (Univ. of Kentucky, Lexington). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Physical, chemical and pozzolanic activity properties were determined for Class F fly ash samples taken from the 18 coal-fired public service electrical power generating plants in Kentucky. The majority of the fly ash samples met pozzolanic activity criteria for use with lime in nonplastic mixtures. Selected fly ash samples from six Eastern Kentucky electrical generating plants were used to design optimum lime-stabilized fly ash base mixtures. Variable lime contents were used under different mixing, molding and curing conditions in order to determine the optimum lime-fly ash blends. Compressive strength, durability, bearing ratio and frost susceptibility properties were used to assess the engineering applicability of the materials. Lime, fly ash and coal (preparation plant) refuse mixtures were designed and evaluated as base materials for various applications. Compressive strength, durability, bearing ratio and frost susceptibility properties were determined to be satisfactory.

6800 (DOE/METC—82-52-Vol.1, pp 358-368) **1980's: the pozzolanic pavement era in American construction.** Nicholson, J.P.; Goeb, E.O. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

A discussion is presented on the past difficulties involved in the development of pozzolanic pavements and the opportunity that now exists for the use of fly ash in all construction paving throughout the US. A good stabilized pavement base can use 12 times the amount of fly ash that an equal amount of Portland cement concrete would use, so that pavement base construction is the single greatest opportunity for fly ash utilization today. This use does not require top grade fly ash, can use fly ash with carbon contents up to 12%, does not require fly ash which has been kept in dry storage, and can utilize fine aggregates as well as the more normally used coarse aggregate. The problem has been the increasing cost and decreasing or unstable supply of lime and hydrated lime that is required with the fly ash use. But kiln dusts from the cement and lime industries can be used as an alternative. (CKK)

6801 (DOE/METC—82-52-Vol.1, pp 369-372) **Meeting today's engineering requirements with today's materials.** Goeb, E.O. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

The properties of N-Viro Crete, a pozzolanic concrete pavement material composed of fly ash and kiln dust, are discussed. The author believes this material to be a good solution to the problems of escalating material costs and material shortages, the need for energy conservation, and the demands for a clean environment. A cost comparison is given of various paving materials. (CKK)

6802 (DOE/METC—82-52-Vol.1, pp 373-385) **Potential of bottom ash.** Jones, D.A. (Ash Management Systems, Inc., Atlanta, GA). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

A discussion is presented on the current utilization of bottom ash from the combustion of pulverized coal. Data are presented comparing concrete blocks fabricated with cement/shale mixes and cement/bottom ash mixes. Bottom ash is also used as a highway base material, and one 5 mile demonstration project in Georgia is described. Other uses for bottom ash is in leaching beds, as a substitute for natural sand in ready mix concretes, as pipe bedding material and floor fill, and for drainage applications. Bottom ash should not be used in concrete which will be exposed because the pyrites found naturally in coal cause the finished concrete to be stained. (CKK)

6803 (DOE/METC—82-52-Vol.1, pp 386-391) **Use of fly ash grouts for concrete pavement maintenance.** Del Val, J. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Grouts in concrete maintenance are used in two ways. As a slurry it is pumped under sagging pavement to fill the void and lift the pavement to its original grade. A grout slurry is also used to subseal and stabilize the subsurface material when void structures develop beneath the pavement as a result of the repeated flexing of the pavement by heavy wheel loads. Fly ash is a better grouting material than the currently used materials because of its particle size, shape, and gradation and its pozzolanic activity. These properties are discussed relative to grouting requirements. The procedure for properly designing, mixing, and applying a cement/fly ash grout is described. (CKK)

6804 (DOE/METC—82-52-Vol.1, pp 392-409) **Use of self-hardening fly ash in the fixation/solidification of inorganic wastes.** Webster, W.C. (American Resources Corp., Fairview Village, PA); Lorenzen, D.J. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

A subbituminous coal, in this case the Powder River Basin coal deposit of Montana and Wyoming, produces fly ash with a significant CaO content resulting in self-hardening properties for the fly ash. The use of self-hardening fly ash for the fixation/solidification of industrial waste slurries is described. The fly ash cementation process was applied to metal refining and electroplating waste slurries, and results are presented of the leaching properties, strength, and permeability of the processed waste. Waste disposal regulations relative to solidification processes are also discussed. (CKK)

6805 (DOE/METC—82-52-Vol.1, pp 410-419) **Fly ash controls the alkali-aggregate reaction of concrete.** Leber, L.E. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

Nebraska has considerable quantities of sand-gravel aggregate readily available over most of the state. However, concrete made with this aggregate is subject to progressive and permanent expansion caused by a cement-aggregate reaction which can destroy the concrete in a matter of a few years in some cases. Laboratory tests indicated that fly ash substituted for part of the cement will inhibit this reaction providing a concrete that is more durable to outside weathering. This paper describes the results obtained from a 5.9 mile test road constructed to study the effects of weathering on a fly ash-cement-Nebraska aggregate concrete. No map-cracking was observed up to seven years later in the concrete sections made with fly ash, while sections constructed without fly ash were map-cracked overall. The test road was paved in 1951. (CKK)

6806 (DOE/METC—82-52-Vol.1, pp 420-427) **Development in the production and utilization of ash in the Netherlands.** Stibbe, F. (Provinciale Gelderse Elektriciteits-Maatschappij, Arnhem, Netherlands); van Ufford, J.J.Q. Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

The Netherlands is in the process of substituting coal for natural gas in its power generating plants. Production of large quantities of fly ash causes concern to a small country with a high population density. Environmental considerations of the disposal or storage and subsequent utilization of fly ash is discussed. Currently or in the near future, fly ash will be used as a cement substitute, in the manufacture of light weight aggregate, and as a filler material in bituminous road constructions. The biggest handicap will be in the variation of chemical composition of the fly ash, since all of the coal must be imported and any one power plant will be firing coal from many different origins. Adequate quality control systems will be introduced for utilizations that are sensitive to chemical composition. The electric companies have formed a corporation whose task it will be to execute contracts for the delivery of fly ash, negotiate new contracts, and to develop new areas of utilization. (CKK)

6807 (DOE/METC—82-52-Vol.1, pp 428-457) **Ash utilization study, Huntley, Dunkirk, Milliken and Greenidge Power Stations.** DiGioia, A.M. Jr.; Niece, J.E. (GAI Consultants, Inc., Monroeville, PA). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

The technical and economic feasibility of marketing fly ash as an alternative to disposal was evaluated in 1978 at Niagara Mohawk Power Corporation's (NMPC) Huntley Station in Tonawanda, New York, and Dunkirk Station in Dunkirk, New York, and at New York State Electric and Gas Company's (NYSEG) Greenidge Station in Dresden, New York, and Milliken Station in Ludlowville, New York. Consideration for potential utilization was limited to broad uses, either presently marketable or in latter stages of development, with the exception of metal extraction. Physical, chemical, and engineering properties of ash from each station were identified, and these properties were used to assess the suitability of the ashes for various applications. Six to ten uses ranging from bulk construction fill to metal extraction were identified for each station. Potential ash markets were delineated on the basis of volume and dollar values, and the actual size of these markets was assessed based on the present quality of the ash and potential improvement in ash quality through the use of beneficiation techniques. Bulk fill and certain cement and concrete uses appeared feasible at most plants. Metal extraction is a promising future use.

6808 (DOE/METC—82-52-Vol.1, pp 458-466) **Three million tons of fly ash in Poz-O-Tec yearly.** Smith, C.L. (Conversion Systems, Inc., Horsham, PA). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

This paper describes the Poz-O-Tec process, an environmentally safe disposal method for the waste sludges of flue gas desulfurization. Thirteen generating plants are currently using this process and another 13 are in the design or construction phases of implementation. The scrubber discharge is dewatered, blended with fly ash and lime, aged when necessary (cold weather and variations in sludges and fly ash can slow pozzolanic reactions), and then placed in landfills. The pozzolanic reactions are relatively slow, but result in unconfined compressive strengths of 50 psi after 2 months and typically 100 psi after one year from landfill placement. Permeability values drop to 1×10^{-7} cm/sec as the cementitious reaction develops, and leachate analysis easily meets regulatory standards. Sufficient interest in the Poz-O-Tec composition has been generated so that development efforts are now directed towards a constructive use of the material rather than as a disposal means. (CKK)

6809 (DOE/METC—82-52-Vol.1, pp 467-483) **Characterization and environmental monitoring of full-scale utility waste disposal sites: February 1982 status report.** Santhanam, C.J. (Arthur D. Little, Inc., Cambridge, MA). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

This paper presents a status report as of February 1982 on the EPA project (EPA Contract No. 68-02-3167) which involves the characterization, environmental monitoring, and engineering/cost assessment of coal ash and flue gas desulfurization waste disposal at six full-scale waste disposal sites. The project is designed to obtain technical background data and information so that EPA can determine the degree to which disposal of these wastes (from coal-fired power plants) needs to be managed in order to protect human health and the environment. To date major accomplishments include: an in-depth site selection process resulting in the selection of six sites; and development of these six sites for characterization and environmental monitoring.

6810 (DOE/METC—82-52-Vol.1, pp 484-491) **Quality control of fly ash from mine to consumer.** Tangen, G.R.; Hickok, W.W. (Cooperative Power Association, Eden Prairie, MN). Jul 1982. NTIS, PC A21/MF A01.

From 6. international ash utilization symposium; Reno, NV, USA (7 Mar 1982).

This paper describes the procedures taken by Coal Creek Station, an 1100 megawatt mine-mouth plant in North Dakota, to insure efficient power generation and high quality by-products. Because large variations can occur in lignite quality within a given bed, an extensive sampling and analysis program was undertaken. Blending of the lignite will occur during normal mining operations to minimize variations, but additional blending, when required, can be performed at the power plant. Part of the fly ash will be used by the scrubbers so that the CaO content will need monitoring. The best quality fly ash is conveyed to a storage silo for sale. Data are given on the range of values found in the chemical composition and physical properties of the lignite and the fly ash. (CKK)

6811 **(EPRI-CS—2713) Technical and economic feasibility of ammonia-based postcombustion NO/sub x/ control. Final report.** Scheck, R.W.; Damon, J.E.; Campbell, K.S.; Jones, G.D. (Stearns-Roger Engineering Co., Denver, CO (USA); Radian Corp., Austin, TX (USA)). Nov 1982. 313p. NTIS, PC A14/MF A01. Order Number DE83900750.

Portions of document are illegible.

Four typical, commercially-available flue gas treatment systems were evaluated as applied to a new 500 MW unit burning low-sulfur Wyoming coal: (1) Exxon Thermal DeNO/sub x/ Process, (2) Kawasaki Heavy Industries Process, (3) Hitachi Zosen Process, and (4) Shell Flue Gas Treating Process. Estimated capital cost of the Exxon non-catalytic systems ranges from $15 to $23/kW, depending on required turndown. With this system, ammonia is injected into the secondary superheater and efficiency probably is limited to less than 55% because of high levels of ammonia carryover. At 300 ppM inlet NO/sub x/, levelized cost is approximately 1.6 mills/kWh, increasing directly with inlet NO/sub x/ concentration to 2.5 mills/kWh at 600 ppM (these and subsequent costs are presented in 1982 dollars). Estimated capital costs of the higher efficiency catalytic systems (Kawasaki Heavy Industries and Hitachi Zosen) range from $53 to $95/kW, with levelized cost being 6.5 to 13 mills/kWh. These systems also use ammonia but employ catalytic reactors located downstream of the economizer, ahead of the air preheater. The catalyst life is the single most important variable affecting cost. The Shell Flue Gas Treating Process removes SO_2 as well as NO/sub x/. Estimated capital cost is $220 to $240/kW; levelized costs are 15 to 17 mills/kWh. To compare this system with others, the SFGT system should be credited for the flue gas desulfurization (FGD) system it eliminates. Significant impact can be expected on air preheater operation due to ammonia carryover from the NO/sub x/ control systems; fouling rates will increase. More test work is needed to determine the severity of this problem and to determine the impact on other downstream systems. Costs presented do not include modifications or operation to reduce the effects of these problems. 46 figures, 64 tables.

6812 **Evolution and removal of pollutants from the gasification of a subbituminous coal in a fluidized bed reactor.** Felder, R.M.; Ferrell, J.K.; Rousseau, R.W.; Purdy, M.J.; Kelly, R.M. (North Carolina State Univ., Raleigh). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 98-108(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

A cyclone, a cold water quench scrubber, and a refrigerated methanol absorber have been used to clean the make gas from the steam-oxygen gasification of a New Mexico subbituminous coal in a pilot-scale fluidized bed reactor. A model developed for the gasifier provides the capability of predicting the make gas amount and composition as a function of gasifier operating conditions. The methanol functioned effectively for acid gas removal. Removal of CO_2, COS, and H_2S to sufficiently low levels was achieved with proper choice of operating conditions and effective solvent regeneration. A wide variety of aliphatic and aromatic hydrocarbons and several trace sulfur compounds are present in the gas stream fed to the acid gas removal system (AGRS). The aliphatic hydrocarbons, ranging from methane to butane, cover a wide range of solubilities. Their presence in all AGRS streams must be anticipated to prevent their emission to the atmosphere. While a wide range of simple aromatics was identified in the gas stream fed to the AGRS, essentially no polynuclear aromatic compounds was found. Apparently, the water quenching process effectively removes these compounds from the gasifier product gas. However, significant quantities of simple aromatics was found to accumulate in the recirculating methanol, indicating a potential for their eventual discharge to the atmosphere. Provision must be made to periodically purge the solvent of these compounds and/or remove them prior to the AGRS through cold traps.

6813 **Fate of alkalis in coal combustion.** Stewart, G.W. (Aerodyne Research, Inc., Bedford, MA); Stinespring, C.D.; Davidovits, P. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 138-144(1982). (CONF-820304—Vol.2). Contract AC21-81MC16244.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The results of these measurements and experiments provide a plausible way to begin an explanation for the distribution of alkali in the ash particulates. To summarize: (1) under typical coal combustion conditions in an atmosphere rich in CO_2 and/or SO_2, the alkalis in the organic fraction do not vaporize but remain bound in the ash as stable carbonates or sulfates; (2) the alkalis in the inorganic fraction diffuse to the surface producing enrichment by a factor of about 13 to a depth of about 100A. The results, however, do not provide conclusive evidence about the fate of the alkalis. The effect of water vapor in the combustion stream has not yet been studied. Clearly, water could have an important effect on the vaporization process. Furthermore, the reasoning we have followed to explain the absence of alkali enrichment in the submicron particles requires that the volatilization of the alkalis in both the organic and inorganic fraction not be significant (say less than 20%).

6814 **Coal ash sintering model and the rate measurements.** Raask, E. (Central Electricity Research Labs., Leatherhead, Surrey, England). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 145-157(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Frenkel's sintering model is a useful introduction to understanding of the mechanism of formation of boiler deposits in the crucial early stages of particle-to-particle bonding. The model sets out unequivocally the rate controlling parameters in sintering, namely surface tension (the driving force for particle coalescence), viscosity (the temperature sensitive parameter) and particle size. Measurements of the rate of neck-growth between the spherical particles demonstrate the validity of the sintering model, but the technique is not suitable for routine assessment tests of the sintering characteristics of different coal ashes. A method of simultaneous measurements of dilatometric shrinkage and electrical conductance has been developed for assessing the deposit forming propensity of coal ashes. The measurements are based on a sintering model which stipulates that the formation of particle-to-particle bonding leads to enhanced conductance and increased density of ash test samples and boiler deposits. There are some coal ashes, rich in sodium which do not behave as predicted from sintering models. With these ashes the sinterpoint temperature defined by the electrical conductance measurements can be over 250 K lower than that indicated by the results of conventional ash fusion tests.

6815 **Capture and retention of sulfur species by calcium compounds during the combustion of pulverized coal.** Case, P.L.; Heap, M.P.; McKinnon, C.N.; Pershing, D.W.; Payne, R. (Energy and Environmental Research Corp., Santa Ana, CA). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* 27: No. 1, 158-166(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

An investigation has been carried out in a bench scale facility to determine under which conditions sulfur species generated during the combustion of pulverized coal can be captured and retained by calcium-containing sorbents. Two series of experiments were carried out: one in which any capture would take place primarily under oxidizing conditions and the other in which significant residence times in the rich zone would allow capture under reducing conditions. Under oxidizing conditions the thermal environment experienced by the sorbent particle appears to be the dominant parameter controlling sulfur capture. This is probably because of

dead-burning: if a sorbent particle's temperature exceeds a certain limit (which depends on the particular sorbent) the sorbent dead-burns and loses its reactivity. The processes controlling capture and retention when the sorbent is maintained under reducing conditions for a prolonged time are more complex. The principle gas phase sulfur species are H_2S, SO_2 and COS and, even though the sulfur species are absorbed, the possibility that the sulfide will decompose during burnout exists. The tests indicate that there is the potential to remove greater than 50% of the input sulfur with Ca/S molar ratios of two when coal is burned under low NO/sub x/ conditions. Further work is necessary to insure that the controlling conditions can be achieved in practical combustors and that the sorbent injection does not adversely impact combustor performance.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 6720, 6726, 6750, 6926, 7275

6816 (CONF-811173—) **Workshop on surface subsidence due to underground mining.** Peng, S.S.; Harthill, M. (eds.). (West Virginia Univ., Morgantown (USA). Dept. of Mining Engineering). Mar 1982. Contract FG01-82FE60030. 303p. NTIS, PC A14/MF A01. Order Number DE82020615.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Portions of document are illegible.

The workshop on Surface Subsidence Due to Underground Mining was held at the Lakeview Inn and Country Club, Morgantown, West Virginia, Nov. 30 - Dec. 2, 1981. It was sponsored by West Virginia University, the US Department of Energy and the US Bureau of Mines. Twenty papers have been entered individually into EDB and ERA. (LTN)

6817 (CONF-811173—, pp 1-16) **Review of subsidence prediction research conducted at Sandia National Laboratories.** Sutherland, H.J.; Schuler, K.W. (Sandia National Labs., Albuquerque, NM). Mar 1982. NTIS, PC A14/MF A01. Contract AC04-76DP00789.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

This paper reviews the results of the subsidence research program at Sandia's National Laboratories. The manuscript highlights the following: the application of empirical methods (profile functions) to the sudsidence above longwall panels in the US; the use of the rubble model to describe the behavior of broken strata as it distends when it falls to the mine floor (or top of the rubble pile) and then is subsequently compacted as it is loaded by overlying elements of strata; and, the application of physical modeling techniques to study the failure mechanisms in highly structured stratigraphy. The capabilities of the latter two are illustrated by comparing their predictions to the results of a field case that has complicated stratigraphy.

6818 (CONF-811173—, pp 17-33) **Consideration of overburden lithology for subsidence prediction.** Tandanand, S.; Powell, L.R. (Twin Cities Research Center, Minneapolis, MN). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Geological differences among various coalfields restrain the applicability of subsidence prediction using existing European methods. To modify these methods for domestic conditions, the Bureau of Mines, US Department of the Interior, developed a method of assessment to evaluate the lithological effects on subsidence in the Northern Appalachian basin by examining data collected from 16 longwall panels in the coalfield. The assessment is partially completed, and the results to date show that the ratio of maximum subsidence to the extraction thickness, known as the subsidence factor, can be expressed in terms of the width-to-depth ratio by a simple exponential equation which has a coefficient tentatively considered as the subsidence index. This index varies with the lithology of a particular site and can be expressed in terms of the percent distribution of weak and strong rocks in the overburden.

6819 (CONF-811173—, pp 34-47) **Measurement and prediction of mine subsidence over room and pillar workings in three dimensions.** Choi, D.S.; Dahl, H.D. (Conoco Inc., Ponca City, OK). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The paper contains a subsidence measurement taken over a room and pillar panel of a mine located in northern West Virginia. A total of 72 monuments were used to determine a three dimensional view of mine subsidence. In addition, the results of measurements were used to compute ground strains with the use of a numerical model.

6820 (CONF-811173—, pp 48-62) **Potential of the zone area method for mining subsidence prediction in the Appalachian coalfield.** Karmis, M.; Haycocks, C.; Webb, B.; Triplett, T. (Virginia Polytechnic Institute and State Univ., Blacksburg). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The role of coal in the energy plans of this nation will continue to increase in the future. As production increases to meet this demand, ground subsidence will become an area of greater concern to the mining industry. In response to this, the industry will be faced with the problem of subsidence control. Subsidence control is only feasible when an accurate method of prediction is available. The zone area computer model is capable of realistic subsidence predictions given the representative values of both the influence constant and zone factors, as shown in the Appalachian case. Finally, it should be emphasized again that surface subsidence is a necessary manifestation of longwall mining. Although it cannot be prevented, at least under the existing technological and economic restraints, it can be controlled, as the European experience has shown. Development of any theories of subsidence prediction and control in this country must be validated with appropriate in-situ measurements. Such data must be collected and analyzed systematically in terms of the various subsidence parameters and processed on a regionalized basis, in order to establish subsidence characteristics in each designated region.

6821 (CONF-811173—, pp 73-87) **Surface sudsidences, surface structural damages and subsidence predictions and modeling in the Northern Appalachian Coalfield.** Peng, S.S.; Chyan, C.T. (West Virginia Univ., Morgantown). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The model needs to be modified to include the effect of seam thickness and furthermore the shape functions will have to be modified so that they can predict the horizontal strains. Two dimensional finite element model has been developed to determine the stress distributions in a building rested in various parts of the subsidence trough. It appears that curvature, not a pure slope, is the major factor that cause stress redistribution, the amount of which depends on the length and height of the building, ground curvature and the properties of the supporting soil and construction materials. In addition, the corners of an opening such as door and window serve as stress risers. It has been demonstrated that structural damages occurred around the edges of the panel where permanent strain and curvature exist. The common types of damage are: cracks in the basement floor, walls and ceiling; separations and dislocations of the frame, brickwork, doors and windows; and tilting of the houses. The most cost effective measure for preventing reducing structural damage is by panel layout. It is most advisable to locate any surface structure as near the center of the panel as possible and orient the longer dimension of the structure parallel to the advancing faceline/pillarline.

6822 (CONF-811173—, pp 88-99) **Evaluation of existing predictive methods for mine subsidence in the US.** Adamek, V.; Jeran, P.W. (Pittsburg Research Center, PA). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Two existing predictive methods were chosen for evaluation; an influence function (Bals Theory) and a profile function (hyper-

bolic). These were applied to several field measured subsidence profiles over United States coal mines. The effect of homogeneous versus non-homogeneous overburden on surface subsidence is demonstrated and the utilization of Bals Theory as a subsidence predictive method for both types of overburden is examined. Measured subsidence profiles over several longwall panels in a local mining area show markedly different characteristics. This does not allow the assumption of local constancy of the functional parameters used in subsidence calculations as practiced in Europe. The major factor is the migration of the inflection point from the edge of the panel toward the centerline. This we attribute to a bridging effect of competent layers of limestone and sandstone in the overburden. This effect does not appear to depend only upon the percentage of strong rock in the overburden, but also the relative location of these strata with respect to the surface and their thickness.

6823 (CONF-811173—, pp 100-123) **Empirical methods of subsidence prediction: a case study.** Hood, M.; Ewy, R.T.; Riddle, L.R. (Univ. of California, Berkeley). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Subsidence profiles above two adjacent panels in Illinois are compared with profiles predicting subsidence behavior obtained using the (i) National Coal Board (NCB, 1975) method, (ii) the profile function method and (iii) the influence function method. The NCB method predicts the maximum subsidence values at the center of the troughs accurately, but, the overall shapes of these predicted profiles do not match the profiles from the measured data well. Consistent values for the angles of draw were measured but these angles were different in the transverse (average value 43 degrees) and in longitudinal (average value 17.5 degrees) directions. A comparison of measured horizontal distances, interpreted as horizontal strain, and the NCB predictions for strain shows that the peak measured strains are greater by a factor of about four than the predicted strains. The relationship between surface curvature and strain is investigated. Problems associated with calculation of surface curvatures from vertical displacement data are highlighted and a recommendation is made for future studies to consider direct measurement of this parameter. Surface curvatures above a moving face are found to be about three times less than the curvatures at the stationary end of the panel. On the other hand, a hyberpolic tangent profile function is shown to serve as an accurate predictive tool for subsidence behavior in two adjacent longwall panels at Old Ben Number 24 mine in Illinois. This function predicts not only the vertical displacements but also the surface curvatures above both panels. Influence functions are shown to be more problematic, although potentially more flexible, in their application than the profile functions.

6824 (CONF-811173—, pp 124-141) **Subsidence profile functions derived from mechanistic rock mass models. A tentative assessment of practical applicability.** Daemen, J.J.K. (Univ. of Arizona, Tucson); Hood, M. Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

A special case of direct connection between a profile function and an influence can be based on the use of mechanistic models. In this case the constitutive models describing the rock mass behavior define the relation between the boundary conditions, the casual effect (i.e. seam convergence), and the resulting effect (i.e. surface subsidence). The use of mechanistic models has potentially more fundamental and broader advantages. This paper only considers, in preliminary fashion, the first phase of an assessment of the use of mechanistic subsidence models, namely the possibilities and problems associated with estimating the large-scale rock parameters needed to use some of the elastic solutions for subsidence calculations by treating the solutions as profile functions. A rational mechanics description of the rock mass movements induced by mining would permit an integrated approach to a total mine analysis. In principle, such an approach should allow utilization of all field information into a single mine model. One aspect of the results obtained by means of analysis with such a model would be subsidence predictions. Conversely, with such a comprehensive model it should be feasible to reverse the analysis sequence, and this should allow information to be gained about seam convergence or pillar loads from subsidence measurements. Specifically for subsidence predictions it would be desirable to be able to incorporate all information obtained by measurements on the surface, at the seam level, within boreholes, as all such physical parameters are related to subsidence occurrences, thereby improving our predictive capabilities. It is postulated here that the framework for such a comprehensive model must be mechanistic, must be as simple as possible, and this approach must be validated by comparisons with field studies.

6825 (CONF-811173—, pp 142-147) **Empirical, continuum and block caving computer models for surface subsidence.** Trent, B.C. (Science Applications, Steamboat Springs, CO). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The following conclusions are based on an examination of the various methods of predicting subsidence: (1) codes utilizing an explicit formulation are much more amenable to large-strain, nonlinear modeling, e.g., subsidence predictions; (2) precise prediction is not likely. The numerical models can be used to evaluate the effects of varying certain parameters; (3) preliminary subsidence calculations indicate reasonable agreement with empirical studies; (4) rock fracturing and joint-slip models are available and have been successfully used in other geotechnical applications; (5) block caving phenomena can be modeled where the geology is sufficiently well known; and (6) the costs of explicit finite-difference calculations are competitive with finite element calculations in two-dimensional formulations and significantly lower in three-dimensional models.

6826 (CONF-811173—, pp 148-155) **Subsidence monitoring - case history.** Conroy, P.J.; Gyarmaty, J.H. (Dames and Moore, Park Ridge, IL). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Work under Contract No. DE-AC22-80PC 30335 began in October of 1980. This paper summarizes the work completed through September of 1981 and presents the results achieved during this period. Technical difficulties encountered during both the installation and monitoring phases are discussed, and recommendations for future work are presented. Stressmeters are durable under in-mine conditions. Results indicate reliable performance. This type of data is useful to subsidence studies and should be included in future studies of this type. Due to the problem of anchor movement and the very small overall movement (less than 0.4 inch), it is felt that the MPBX is not a cost-effective instrument for the geologic conditions in the area under study. As with the MPBX, the floor differential movement that occurred at Station 2 was very small (less than 1/2 inch). It is felt that when dealing with subsidence model development for mines located at depths not greater than 500 feet, these small movements will be undetectable and insignificant. Reevaluation of the current monument layout has indicated that subsidence contours cannot adequately be drawn for the areas over the corners of the panels. It is, therefore, recommended that monument lines be installed at angles of approximately 45 degrees from the centerline in the area over the corners of the panel to better evaluate the subsidence pattern. It has been found that much of the horizontal monument movement is being influenced by topographic effects. Because of its importance to the overall usefulness of subsidence data, it is felt that the collection of surface strain data should be increased in future studies of this type.

6827 (CONF-811173—, pp 156-163) **Subsidence monitoring over western coal mines.** Allgaier, F.K. (Bureau of Mines, Denver, CO). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The Bureau of Mines' Research Center initiated a subsidence research program in 1978. The short term goals of the program were to determine practical methods and equipment for measuring subsidence and demonstrate these methods by monitoring subsidence at several mines having mining, geologic and topographic variables typical of those encountered in the western United States. Data from the monitoring program would be supplied to cooperating mining companies and used by the Bureau to accomplish the

long term objective of developing and validating subsidence prediction techniques applicable to mines inthe West. subsidence monitoring is being conducted at five mines in Colorado and Utah with substantially different mine plans, mining methods, depths of cover, and topography. The monitoring procedures used at each site are similar and include designing the monitoring network layout, installing the subsidence monuments, initial and periodic surveying of the monuments, and processing the survey data. The network layout, surveying methods, and types of monuments vary according to the conditions at the individual sites and the type of data being collected.

6828 (CONF-811173—, pp 164-181) **Monitoring subsidence in the west: problems and analysis.** O'Rouke, J.E. (Woodward-Clyde Consultants, San Francisco, CA). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

This paper describes some of the results of a project for the design and demonstration of subsidence monitoring systems for underground coal mines. The project was designed to test monitoring systems described in an earlier feasibility report (O'Rourke and others, 1979). General objectives of the project were to develop reliable cost- effective monitoring systems for use above caving-type mining operations, over supported mines, and in urban undermined areas. Topics selected for discussion in this paper include a description of the instrumentation systems, the site conditions, problems of installation, resulting recommendations and an overview of subsidence performance data obtained. There were some particularly difficult problems of installation to overcome at this site. Some of these could be experienced at any surface or underground project, others are probably more directly related to Western coal fields. Almost any subsidence monitoring program may face the following difficulties: instrument damage due to large ground movement; instrument damage due to mining operations; and changes or delays in mining operations which affect subsidence monitoring objectives. Some additional difficulties facing a Western coal fields program can include: mountainous terrain, severe winters, remote locations, and deep coal seams.

6829 (CONF-811173—, pp 182-197) **Some aspects of subsidence monitoring in difficult terrain and climate conditions of Rocky Mountains Western Canada.** Fisekci, M.Y. (Mining Research Labs., Calgary, Alberta); Chrzanowski, A. Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Subsidence measurement methods, applied over the thick and steep seam mining in the Rocky Mountains Region of Western Canada are described. The studies to date indicate that two new subsidence monitoring techniques appear to be most suited methods for our conditions. The computerized telemetry and aerial photogrammetry systems are being tested for the reliability of the systems during the winter months within the network of laser surveying over the workings of the new hydraulic mine. The site particulars and the mining method of the concerned area have been described briefly. The observation over the old hydraulic mine indicate that panels adjacent to each other do not obey identical subsidence phenomenon.

6830 (CONF-811173—, pp 207-219) **Profile, strain, and time characteristics of subsidence from coal mining in Illinois.** Bauer, R.A.; Hunt, S.R. (Illinois State Geological Survey, Champaign). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

Two types of subsidence occur in Illinois: pit and sag/trough. Pit subsidence is a circular hole in the ground, generally with a diameter of 2 to 40 feet and vertical sidewalls. This subsidence is found over shallow mines (<165 feet) with incompetent bedrock overburden. Sag subsidence is an equidimensional depression developed over room-and-pillar mines. Trough subsidence forms over elongate high extraction retreat or longwall panels. Longwall mining in Illinois has a slightly lower percentage of subsidence for comparable width/depth values and smaller angles of draw than in the United Kingdom. These lower values are probably due to rock mass properties more resistant to subsidence movements in Illinois. Similar variations in percent subsidence and smaller angles of draw are found within Illinois. The average angle of draw near geologic structures such as faults, anticlines, and monoclines is 20 degrees. Areas away from geologic structures have an average angle of draw of 13 degrees. This indicates that the rock mass is less stiff in areas affected by structures. Strain data presented are calculated by using crack development in tar and chip roadways from subsided areas over abandoned room-and-pillar mines. These strains are 2 to 4 times greater than the strains experienced in the United Kingdom and are closely parallel to strains experienced in the Silesian Basin of Poland. A time factor defining the length of time from the abandonment of mining to the date of occurrence of subsidence over the mine does not exist in Illinois. Variables are presented that may control a subsidence time factor.

6831 (CONF-811173—, pp 225-230) **Subsidence monitoring plan of longwall panel: a case study, Kitt Mine No. 1.** Kolesar, J.E.; Palmer, E.C.; Scovazzo, V.A. (D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

D'Appolonia Consulting Engineers, Inc. (D'Appolonia) is presently involved in a subsidence characterization study of two longwall panels at Kitt Energy Corporation's Kitt No. 1 Mine in Philippi, West Virginia. Briefly, the investigation involves monitoring: surface movements measured by survey and instrumentation placed over a grid established above the working area; rock mass movements in the interburden measured from instrumentation installed in boreholes drilled from the surface; and near-seam deformations and stress redistributions measured from instrumentation placed in the gate pillars, floor, roof, and panel. This document reviews the stratigraphy and geological conditions at the Kitt Mine site, the mining plan, and the surficial, interburden, and in-mine monitoring plans cited above.

6832 (CONF-811173—, pp 231-237) **Instrumentation plan for monitoring ground movements associated with pillar extraction mining at the Kitt No. 1 Mine in northern West Virginia.** Speck, R.C.; Bruhn, R.W.; Gray, R.E. (GAI Consultants, Inc., Pittsburgh, PA). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The US coal industry has long utilized the pillar-extraction mining technique as a method for maximizing coal recovery. Like longwall mining, it causes large-scale movements that progressively propagate from mine-level to the ground surface and may affect the groundwater regime, surface drainage and surface structures. The US Department of Energy, in an effort to foster increased use of total extraction mining techniques, has recognized the need for a better understanding of these movements that will lead to a greater compatibility between coal mining and present and future land use. As part of that goal, GAI Consultants, Inc. is currently installing instrumentation to monitor the ground movements associated with pillar extraction mining at Kitt Energy Corporation's No. 1 mine in northern West Virginia. This instrumentation program represents the most extensive monitoring of ground movements associated with pillar-extraction mining that has been conducted in the United States to date. The results promise not only to fulfill the direct needs of the US Department of Energy subsidence research program, but will also provide needed practical information to mining compares, land users, planners, and local and state governments.

6833 (CONF-811173—, pp 238-252) **Building response and mitigation measures for building damages in Illinois.** Mahar, J.W.; Marino, G.G. (Univ. of Illinois, Urbana). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

This paper summarizes observations and measurements of twelve cases in which buildings were damage as a result of mine subsidence. The structures were built above room and pillar mines where the mined coal seams are typically 6 to 8 ft. thick. The mines are located 35 to 220 ft. below the ground surface and operated as recently as several months to more than 100 years prior to the sub-

sidence events. Two types of surface depressions develop as a result of subsidence: pit and sag. The important parameters in pit substance are the size of the pit with respect to the size of the foundation. Structures least susceptible to pit subsidence are founded on reinforced concrete wall footings or on concrete slabs. Severe damage has occurred where the size of the pit was approximately the same as, or greater then the size of individual wall or column footings. Pits are backfilled in order to prevent additional damage either by enlargement of the existing pit or formation of new pits. The behavior of a building in sag subsidence depends on the location and orientation of the structure in the sag, the character of the ground movements, the structural characteristics and interaction effects, and the presence of construction joints and presubsidence cracks. Damage levels tend to be high where there is interaction between foundation walls or where there is a strong attachment between wood frame structures and their foundations. Damage also tends to be severe when an individual structure is supported on two or more different types of foundations or when the superstructure contains short, weakly connected sections. Mitigation of damage to structures has been foundation grouting, underpinning, wall shoring, and interior bracing. These techniques have worked well and have minimized further damage.

6834 (CONF-811173—, pp 253-258) **Effects of mine subsidence on structures - mine subsidence insurance program in Illinois.** Yarbrough, R.E. (Southern Illinois Univ. Edwardsville). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

As a result of concern the citizens of the State of Illinois who owned structures above underground mine workings, the Illinois State Legislature passed House Bill 158 in 1978. This bill amends the Illinois Insurance Code and creates the Mine Subsidence Reinsurance Fund which is an insurance pool that is to receive a state appropriation of $500,000 as start-up money. The Fund is to return this appropriation to the State and is to remain self-supporting from premiums. The Mine Subsidence Insurance Act went into effect October 1, 1979, and the bill provides that property owners in the State of Illinois may purchase up to $50,000 of mine subsidence insurance which is attached to their fire insurance policy. The deductible is normally 2%, but cannot be less than $250 or more than $500. The annual rate structure for residential strucuteres in 1981 for $50,000 coverage is $10 (frame), and $12 (masonry). The rate structure for commercial buildings is based on the value of the building and rate for $50,000 maximum coverage is adjusted upward. The insurance was mandated by the State Department of Insurance and rolled onto the insurance policies of the homeowners in 34 counties which had been recognized as having sufficient exposure to subsidence damage to be covered by the Act. One percent or more of the land surface is undermined in each of the 34 counties. In the other counties undermined in the State of Illinois, insurance is available to the homeowner upon request to the private insurance carrier. The initial experience of the plan is described.

6835 (CONF-811173—, pp 259-267) **Research needs in subsidence abatement over abandoned mines.** Gray, R.E.; McLaren, R.J. (GAI Consultants, Inc., Monroeville, PA). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

The Office of Surface Mining Reclamation and Enforcement is preparing and Abandoned Mined Lands Reclamation Control Technology Handbook. GAI Consultants, Inc., recently prepared Chapter 2 on Mine Subsidence Control which contains a summary of subsidence abatement measures plus two new decision matrices for evaluating the subsidence abatement options that might be considered for a particular problem. These decision matrices are presented for information. Review of the subsidence abatement methods resulted in identification of items where research may impact the current state of technology in mine subsidence control. These research needs are presented to stimulate discussion of their importance in subsidence abatement and to encourage funding agencies, researchers, and practitioners to work on them. United States technology in subsidence abatement over abandoned mines is comparable or exceeds European technology. However, improvements are both possible and necessary. Data are required on: (1) the long-term value of stabilization methods and materials; (2) the relative importance of lateral confinement of existing coal pillars versus total void filling; (3) backfill erosion and possible leaching of metals or other contaminants; and (4) corrosion resistance of injected or structural materials.

6836 (CONF-811173—, pp 268-273) **Piping induced subsidence over an underground mine.** Johnson, A.M.; Hodek, R.J.; Frantti, G.E. (Michigan Technological Univ., Houghton). Mar 1982. NTIS, PC A14/MF A01.

From Workshop on surface subsidence due to underground mining; Morgantown, WV, USA (30 Nov 1981).

This case history of the Sherwood Mine demonstrates that surface subsidence over underground mines can be caused by the piping mechanism, providing that certain basis requirements are met. These are: (1) an easily erodible unit overlying the mine voids; (2) an adequate source of water that has access to the erodible material positioned so that flow can occur; and (3) a conduit or channelway that allows the hydraulic transport of erodible material into the mine reservoir. These conditions, first enumerated by Allen (1969), are present at the Sherwood Mine: (1) thick unconsolidated and easily erodible glacial sands overlie the mine; (2) large volumes of surface water are present in the overburden (more than 6 million gallons of water were pumped daily to dewater the overburden while the mine was operating); and (3) faults, boreholes, and previous rockmass failures serve as channelways into the mine void reservoir. Allen noted that a cap of sufficient competency should be present over the erodible bed to maintain a roof over the cavity. Although such a capping is present at the Sherwood Mine in the form of a very competent glacial till some 10 m thick, laboratory modeling tests suggest that a capping layer may not be necessary for piping voids to form. Our experience has shown that the cavity originates at the point of water entrance into the channelway. It enlarges as additional soil is removed assuming an approximately hemispherical shape. Growth of the cavity continues as entering groundwater creating tensional stresses in the overlying sands and gravity collapse. The collapsed sand is continually removed by flowing water.

6837 (DOE/EV/05699—T1) **Environmental control aspects of lignite utilization. Final report.** McFarland, A.R.; Bertch, R.W. Jr.; Ortiz, C.A. (Texas A and M Univ., College Station (USA). Dept. of Civil Engineering). 15 Jul 1981. Contract AS05-78EV05699. 17p. NTIS, PC A02/MF A01. Order Number DE83002241.

Portions of document are illegible.

A specialized stack sampling device has been developed as the first step in characterizing the biological activity and chemical composition of effluents from ligite fired electrical generation power plants. The system is basically a centripeter-type separator which has a cutpoint of 2.5 μm and has the capability for collection of gram-quantities of size fractionated particulate matter. The system has been laboratory tested with monodisperse aerosols to develop the fractional efficiency and wall loss curves. The former shows the cutpoint is 2.5 μm and the latter shows the wall losses at the cutpoint are 6%. For sizes near the cutpoint the losses are less than 5%; however, the losses increase at 6 μm and rise to 13% at 10.7 μm.

6838 **Effects of peat harvesting and gasification on air quality.** Ertugrul, A.M.; Sober, R.F. (Williams Brothers Engineering Co., Tulsa, OK). pp 173-188 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Major identified potential sources of airborne pollutants from commercial peat harvesting and gasification operations are: peat harvesting, storage, handling, and crushing operations; claus sulfur plant and other process gas vents; flue gas from plant boilers; exhaust emissions from vehicular traffic and heavy machinery; and secondary sources resulting from peat mining and gasification projects. These sources are similar to those expected in coal mining and gasification operations of comparable size. The major potential air pollutants from the sources listed above are particulate pollutants,

sulfur oxides (SO/sub x/), nitrogen oxides (NO/sub x/), hydrocarbons (HC), carbon monoxide (CO), carbon dioxide (CO_2), and aldehydes. Among these potential pollutants, particulates, SO_2, NO_2, reactive hydrocarbons, and CO are regulated by the National Ambient Air Quality Standards (NAAQS), as established by the US Environmental Protection Agency (EPA) under the requirements of the Clean Air Act of 1970 (CAA). An analysis of the design of a peat gasification plant based on the IGT PEATGAS Process shows that air pollution control techniques developed for coal gasification plants can limit pollutant emissions to within New Source Performance Standards (NSPS). This is facilitated by the relatively low sulfur content of peat. Computer simulation of air pollutant dispersion from a PEATGAS plant producing 80 x 10^9 Btu/day of SNG shows that Prevention of Significant Deterioration (PSD) requirements for a Class I Area could be met within as close as 10 miles to the plant facility. It is estimated that emissions of fugitive peat dust from a hydraulic peat harvesting operation would be negligible. Various control measures are available to deal with emissions resulting from other types of harvesting techniques as well as associated activities such as storage and handling.

6839 **Peat: ecologically sound resource development.** Lofton, S.M. (Williams Brothers Engineering Co., Tulsa, OK). pp 189-199 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

In today's world, any resource management plan must be viewed in terms of overall system stability. A system is defined as anything that functions as a whole organism or a large peat bog, is based upon and maintained by energy. The ultimate goal in any resource development plan must be maintenance of system stability. Any ecosystem disturbance that results in a situation in which energy input exceeds energy yield is unacceptable in terms of ecologically sound resource management. Peatlands occur in all portions of the world. Wherever waterlogging creates anaerobic conditions, peat may accumulate due to low-level decomposer activity in organic materials. Because peat occurs in a large variety of ecosystem types, ecologically sound management of these valuable natural resource deposits must employ a variety of methods. Sound management of some peat deposits may be simply preservation. Local conditions will dictate development practices for other deposits. A whole-system approach to peat development is recommended. A team consisting of hydrologists, air quality specialists, biologists, geologists, soil scientists, and engineers should be organized to study the peat system, plan the best method or methods of development, and implement plans. Computer modeling and pilot projects are recommended to incorporate available information available for successful reclamation of postharvest areas. Many are currently being tested in a variety of research projects in the United States, Canada, and Europe. Using the best available technology, ecologically sound development of selected peat resources appears promising if proper team effort is employed throughout the project.

6840 **Potential effects of peat mining.** Clausen, J.C. (Minnesota Dept. of Natural Resources, St. Paul). pp 201-203 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The potential effects of peat mining on water resources are discussed. These vary with a number of factors, including peat type and depth, peatland type (bog or fen), the method of mining, the location of the mining operation in the watershed, and climate. Generally, peat mining operations that require drainage (milled and sod peat) are likely to reduce peak flows and increase low flows and total annual flow. The net result is that flow is redistributed more evenly throughout the year. Peat mining requiring drainage also has the potential to increase suspended sediment and nutrients in discharge waters.

6841 **Peatland reclamation.** Farnham, R.S. (Univ. of Minnesota, St. Paul). pp 205-207 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The reclamation of mined peatlands in several European countries has been a common practice for many years. Many of these mined areas are currently used for crop and tree production, and others are now conservancy areas, wildlife habitats, or lakes and ponds. In Ireland and Poland, the principal use for mined peatlands is forage or grass production, as these crops are well suited to the lower peat strata or the mineral substrate.

6842 **Techniques for the assessment of bog hydrology, harvesting and mitigation of water quality impacts resulting from peat harvesting.** Hazen, C.G.; Beeson, R.J. (Williams Brothers Engineering Co., Tulsa, OK). pp 219-240 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Hydrogeologic characterization of peat accumulation including storm events, snow melt, groundwater flow, and subsoil/peat chemical interaction are described in this paper. Descriptions of both dry and wet peat harvesting techniques are presented. Large-scale hydraulic peat harvesting will involve control of surface and groundwater flows over large areas. A preliminary water budget indicates that civil works associated with this operation will provide sufficient water for a PEATGAS plant operation. In an integrated peat harvesting/water quality/land-use plan, the adoption of a multiple land-use/reclamation concept enables tailoring of the hydrologic response over a wide range, including duplication of preharvest conditions. Although additional field work is necessary, the use of natural processes to mitigate water quantity and quality impacts may greatly reduce the time and energy required to construct civil structures for water quantity and quality control. To adequately characterize the hydrologic system of a bog area, the concept of the reference watershed was developed. Data obtained by monitoring this reference watershed was developed. Data obtained by monitoring this reference watershed would provide hydrogeologic boundary conditions necessary for developing a comprehensive peat harvesting/water/quality/land-use plan.Cold weather design and operating conditions must be considered for peat harvesting in the proposed Minnegasco lease area. These considerations will manifest themselves in areas ranging from slurry pipeline protection, through harvested-peat storage, and harvesting rates, to spring break-up preparations. Special harvesting, transportation, and seasonal preparations are conceivable using the advantage of frost penetration to provide for surface transportation, ditch preparation, and, perhaps, a variation in backhoe or heat/steam harvesting.

6843 **Peat and the environment.** pp 241-256 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

This paper outlines the environmental, social, and economic effects of harvesting and gasifying peat on a commercial scale. Large-scale peat harvesting and gasification operations will affect the environment through the media of air, water, and land, but these impacts are controllable. In most instances, the environmental impact of commercial-scale peat gasification will actually be beneficial.

0110 Reserves And Exploration

6844 **(BMFT-FB-T—81-220) Time-saving methods adaptable to mining for utilization and interpretation of results of structural studies in forefield research by using new technologies.** Murawski, H.; Rueller, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 125p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750410.

The research program, Development of Structural Treatment of Tectonics for Application in Coal Mines (1975-1977), has confirmed that structural data can be used for diagnosis of tectonics

in the Ruhr coal mining area. This work was carried out in already outcropped subterraneous parts of mines. The present research had to make available these results for the mining industry by improvement of the survey and analysis methods, intensification of electronic data processing and rationalization of the whole working process. The system developed for this purpose permits sufficiently fast information about the tectonic situation in the forefield and is therefore, in combination with other methods, a practicable aid for the miner. The possibility to combine geophysics, well-logging and structural surveys in forefield research was used.

6845 **Peat resources: classification, properties and geographical distribution.** Farnham, R.S. (Univ. of Minnesota, St. Paul). pp 7-18 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Peat is a natural organic deposit which occurs in wetland environments throughout the world under special circumstances. This paper discusses the important properties of peats, their formation, classification and geographical distribution in the US and the world. The world reserves of peat are estimated to be over 320 million hectares with the most extensive peatlands occurring in the northern hemisphere. Definitions pertaining to peat and peatlands in the literature are often confusing, and a uniform standardization system has recently been approved of by the International Peat Society. A committee of this society has been assigned the task of improving definitions and terminology. Peat has been used extensively in Europe for many years as a fuel for electricity generation and for district heat. It has also been used as an organic soil for the production of food, feed and fiber crops. Other uses for peat include production of horticultural peat products and chemicals. The potential of peat as an energy source in the United States is currently being evaluated because the reserves are enormous and many peat deposits are suitable for conversion to solid, liquid, or gaseous fuels.

0120 Mining

REFER ALSO TO CITATION(S) 6816, 6817, 6818, 6819, 6820, 6821, 6822, 6823, 6824, 6825, 6828, 6829, 6830, 6831, 6832, 6833, 6834, 6835, 6836, 6842, 6925, 8460

6846 **(BMFT-FB-T—81-199(1/2)) Operational experience on hydro-mechanical coal-getting and hydro-transport of hard coal at 'Hansa' hydromine. Vol. 1/2.** Adamek, R.; Beyer, E.; Blodau, H.J.; Diestelkamp, K.H.; Dunczyk, W.; Harzer, J.; Kortenbusch, W.; Louis, O.; Maybach, S.; Meister, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1981. 893p. (In German). NTIS (US Sales Only), PC A99/MF A01. Order Number DE82750337.

In the Federal Republic of Germany coal extraction from steeply inclined seams slumped to 3% of the total output (with reserves of 10%) due to lacking potential of mechanisation. From the implementation of hydro-mechanical coal-getting in deposits of the above type was expected a number of advantages in respect of safety, mining technology, and economics, all encouraging enough to run large-scale trials at Hansa colliery in Dortmund-Huckarde which had been scheduled for close-down during 1975. Within the period from October 1, 1977, through November 13, 1980, the hydro-technical equipment was developed to operational maturity, with a 50% sponsorship of the Federal Ministry of Research and Technology. As to the mining aspects of the project, however, unexpected difficulties emerged which forbid any application of hydrotechnics in deposits of the Hansa type. Among these difficulties have to be mentioned above all excessively high preliminary expenditures, too thin coalbeds, increasing occurrance of tough coal, poor performances at extraction points, the decentralised structure of the colliery including 30 to 40 widely spread extraction points, and the unsafe local ventilation with retreat mining. High operational losses along with the lacking development potential led to a premature abandonment of the R and D projects on 'Optimization of hydro-mechanical coal-getting' and to the closing down of this hydromine on November 30, 1980.

6847 **(BMFT-FB-T—82-074) Pneumatic stowing with lateral discharge in coal faces with thick seams.** Sielaff, H.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750719.

By the present research project a method of introducing an early bearing and as compact as possible pneumatic stowing in thick coal beds was to be developed. In an early phase the pneumatic stowing method with lateral discharge and in conjunction with special chock supports as used at Nordstern colliery was tested. Due, however, to difficult geological conditions in the coal bed and to unsufficient stability of the special chock support the trial failed after 7 months. Then the whole system was modified to pneumatic stowing with front discharge and using shutterings. This method turned out to be unsuccessful as well. It was only when introducing a shield support designed for pneumatic stowing with front discharge in another panel of the same coal bed that difficulties in coal-getting from coal beds of that thickness and in conjunction with pneumatic stowage could be overcome.

6848 **(BMFT-FB-T—82-115) Experimental operation of a remotely monitored and controlled computer based mineral transport system comprising belt conveyors and bunkers.** Floh, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 41p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750999.

Experimental operation of the computer-monitored and controlled overall system was completed successfully: Start-up and shut-down of the individual conveyors carried out remotely from the conveyor control center on the surface, either manually or by the process computer AEG 80-20/4. The control computer furthermore is in charge of transport volume optimization for supplying the two main winding shafts and the inter-level drift belt. For reducing the volume of cable and hardware equipment the signal transmission between a control center on the surface and underground conveyor control units is assured by a frequency/time multiplex transmission system Geatrans 21. This concept enables transmission of 512 digital informations from 4 belt control units to the control station and the transmission of 128 control signals and 8 pre-set value signals from the control station to the underground conveyor control units by means of a twin-conductor telephone cable. For reducing the volume of cable and hardware equipment multiplex transmission system Geatrans FOM 200 i whose 200 high frequency channels are run by a twin-conductor special cable which assures remote energy supply. Shut-down and interlocking systems, belt slip and speed monitoring without mechanical contact, and brake disc and coupling temperature monitoring are integrated into the FOM 200 i system. The same applies to temperature monitoring of bearings and gear oil. The other monitoring units are coupled to the system by potential-free contacts. A local control of a belt drive including ancillary systems is assured by the logic system Logistat 60 i and the remote control system FOM 200 i. The logic system is an autonomous link between the two abovementioned remote control systems and thus enables a hierarchic control structure. A total of 2000 operations and trouble reports reaching the belt control center on the surface are recorded by a second process computer, with date and hour.

6849 **(DOE/ET/12072—T14) Economic evaluation of the blind-shaft borer (BSB).** (Fuel and Mineral Resources, Inc., Reston, VA (USA)). May 1981. Contract AC01-78ET12072. 186p. NTIS, PC A09/MF A01. Order Number DE83003770.

Portions of document are illegible. Printed copy available until stock is exhausted.

The objective of the present study is to assess the economic feasibility of Blind Shaft Boring versus alternate methods of shaft sinking. In Section 1 a review is made of two previous economic analyses. Comparisons have been made between projected performance of a fully commercialized Blind Shaft Borer (BSB) and the actual results of the DOE sponsored field trial at Oak Grove, Alabama. Problems encountered with the prototype are fully discussed and considered. The purpose of this review is to determine if the methodology used in the previous reports is valid. For a better fa-

miliarization of the reader with the details of the Paul Weir Co. and TRW studies, a rather comprehensive review of these two studies is given in Appendix A. In Section 2, the operating costs for a commercialized BSB, including amortization of capital costs, are determined. Probable costs associated with shaft sinking using a second generation BSB are predicted in dollars per foot and include mobilization, capital, and operating costs. In Section 3, BSB costs derived in Section 2 are compared with costs of alternate methods including: (1) Conventional Shaft Sinking, (2) Large Diameter Drilling, (3) Multi-Pass Reaming Methods. In Section 4, a Sensitivity Analysis is performed to determine the relative influence of parameters such as shaft diameter, shaft depth, penetration rate, etc. The conclusions of the report and the main topics addressed in the study are summarized in Section 5.

6850 **(NP—2906252) Annual report 1980 of the Versuchsgrubengesellschaft m.b.H.** (Versuchsgrubengesellschaft m.b.H., Dortmund (Germany, F.R.). Versuchsgrube Tremonia). [nd]. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82906252.

Experiments and tests were carried out in the fields of explosions and blasting; pit fires and protection of workers; shaft hoisting and machinery. Safety and measuring techniques are discussed as well as data acquisition and data computerized processing.

6851 **(NP—2906265) Annual report 1979 of the Versuchsgrubengesellschaft m.b.H.** (Versuchsgrubengesellschaft m.b.H., Dortmund (Germany, F.R.). Versuchsgrube Tremonia). [nd]. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82906265.

In the annual report, experiments and tests were carried out in the fields of explosions and blastings; pit fires and protection of miners; shaft hoisting and machinery; measurement and computing.

6852 **Technical and economic aspects of hydraulic coarse solids transportation at the Hansa hydraulic mine.** Harzer, H.; Kortenbusch, W. (Bergbau, AG Westfalen, Bergkamen-Oberaden, Germany). pp 205-212 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Hydraulic installations were operated for three years at the Hansa hydraulic mine under unfavorable operating conditions. These conditions made further development of all installations obligatory. The experiences gained with all installations were so extensive that it is now possible to arrive at optimal technical designs. By way of improved methods of calculation of individual operating areas, etc., it was also possible to greatly improve the economic aspects of the process. The operational reliability and economic nature of hydraulic shaft transportation has been proven. It can be said that coarse solids can be transported hydraulically for at least 10 km, and up to several tens of km, by using a three-chamber pipe-feeder. In case of considerable distances, or to overcome terrain-occasioned height differences, one can insert pipe feeders in the pipe line as pressure intensifier elements. This sensible means for extending the scope of hydraulic transportation can be used to particular advantage when the hydraulic transport with piston pumps becomes otherwise uneconomic, due to the heavy dewatering costs arising as a result of the presence of very fine particle sizes. One should also be aware of the considerable flexibility available with a pipe-feeder system. Solids transportation tests were undertaken within the velocity range of 2.0 m/s (with some 350 m^3/h) to 5.5 m/s (with some 900 m^3/h) and with pressures ranging from some 90 to 125 bars, without having to undertake any constructional alterations whatever. Quite apart from the fact that one could not use piston pumps for transporting coarse solids of up to 100 mm diam, a pressure and volume variation of the above mentioned extent would also involve the use of several types of pumps.

6853 **Assessment of peat mining methods considered for proposed Canadian fuel peat operations.** Fraser, J.A. (Montreal Engineering Co., Ltd., Toronto, Ontario). pp 87-92 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

This paper describes alternative peat mining methods considered to meet some of the various conditions encountered on virgin Canadian peatland. These mining techniques are generally based on current peat technology practiced in other parts of the world that may be applicable in some of the peat regions of Canada. The technical review of mining methods places particular emphasis on fuel supply for electric power generation. Cost estimates for peat production in Canada are discussed, and socioeconomic aspects of a large-scale fuel peat operation are outlined. This paper also makes recommendations for steps to be taken in the development of a fuel peat industry in Canada.

6854 **First Colony Farms, Inc., experimental peat harvesting program.** Campbell, R.N. (First Colony Farms, Edenton, NC). pp 93-96 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Methods used in the harvesting of peat in the peatlands belonging to First Colony Farms, Inc., are described in this paper. Both sod peat and milled peat harvesting methods are in use. Peat is stored in wind rows. (DMC)

6855 **Environmentally sound peat harvesting technique.** Johnson, B.V.; Connor, K.; Swan, S.A. (Bureau of Mines, Minneapolis, MN). pp 97-106 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

The realization of peat as a major energy source in this country depends upon suitable harvesting and dewatering techniques and environmental controls. European technology regarding peat storage and combustion may have potential application in the United States and is currently under study. The predominant harvesting method in Europe is the milled peat method, but with this method, it is estimated that large areas of land, up to 400 square miles (1), would have to be drained and devegetated for nearly 25 years in order to fuel proposed peat-fired plants. Major environmental problems would be encountered that probably would be insurmountable. For this reason, alternatives to the milled peat process have received preliminary investigation by the Bureau of Mines. A hypothetical Single-Pass Peat-Harvesting System (SPPHS) currently under investigation would have the advantages of faster start-up and reclamation and would require about 5% of the annual land use as opposed to the milled peat process. The entire depth of peat would be harvested in one pass, and fast dewatering and reclamation techniques could be used. A single-pass system could consist of a hydraulic dredge, a pipeline, and a dewatering station. A preliminary economic analysis estimates that fuel peat could be obtained for an onsite cost of approximately $1/million Btu.

6856 **Peat harvesting/mining in the USSR.** Prodromidis, L. (Pansat Enterprises, New York, NY). pp 111-132 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Pictures of Soviet designed equipment for use in the mining and harvesting of peat are presented. The equipment is used for clearing the land of trees and stumps, digging open ditches for draining, peat extraction, drying, storage, and transport. (DMC)

0130 Transport And Handling

REFER ALSO TO CITATION(S) 6697, 6702, 6751, 6852, 6924

6857 (CONF-8105173—, pp 17p, Paper 14) **Reduction of the total sulphur content of coal through enrichment and utilization of the pyritic sulphur of hard coals.** Blagov, I.S.; Molyavko, A.R.; Yagodkina, T.K. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Coal is one of the major forms of technological and energy fuel in the fuel and energy balance of the Soviet Union. Much importance is attached to reducing the level of harmful components in the coal used, primarily sulfur compounds, the content of which varies widely in coal from various basins. This is of great importance in satisfying consumer requirements and protecting the environment. Sulfur is present in coal in the form of organic and inorganic compounds. Inorganic compounds are found in basic pyrites. A classification of the various types of sulfur in coal is given in the paper. A classification of sulfur coal into three groups, according to how readily they can be upgraded, is suggested. The method of centrifugal enrichment in dense media, flotation and high-gradient magnetic fields are described. Various methods to increase the magnetic susceptibility of pyrites and a fundamentally new biocatalytic method of desulphurizing coal are proposed. The paper mentions promising techniques for upgrading sulphurous coking and fuel coal that have been developed. A basic process for the pneumatic upgrading of brown sulfur coal to obtain three products - coal concentrate, iron pyrites and clay - is suggested. A process that has been developed for the pneumatic upgrading of industrial waste and the circulating product of tumbling mills at thermal power stations with a view to obtaining pyrite for sulphuric acid production is described. The economic feasibility of industrial utilization of sulphurous wastes from coal upgrading is demonstrated.

6858 (CONF-8105173—, pp 23p, Paper 21) **Coal preparation and the reduction of pyritic sulphur.** Jenkinson, D.E.; Cammack, P. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Because the chemical composition of coal can vary appreciably, before a reduction in sulfur can be examined in terms of coal preparation techniques it is first necessary to define how sulfur is present. Evidence available suggests that a general pattern of sulfur distribution is most unlikely to be found and that each type of coal will have to be examined individually. Insofar as an overview can be given, the average total sulfur of all coal sold in the United Kingdom is 1.4 percent, but for supplies to power stations it is 1.6 percent of which 0.8 percent (air dried basis) is organic and cannot be reduced by the physical principles employed in coal preparation technology. Among the main washing processes the dense medium in which controlled separations can be made at any relative density, but particularly at 1.35 and below, offer the best facilities for achieving a reduction in sulfur through the removal of pyrites. It appears however that at best about 50 percent can be removed, but more normally the figure is 30 to 35 percent. To improve the removal of pyrites coal will have to be crushed and, from work on both British coals and those from other countries, it appears that the size will have to be a maximum of 3 mm, sometimes even 1 mm, with significant proportions below 500 microns. Froth flotation based on the surface chemistry of the coal will then have to be the main process to improve quality. Although pyritic sulfur may be liberated by crushing and removed by flotation, the resultant product will almost certainly be unacceptable on account of poor handling qualities. Therefore more vigorous attention is being given in the United Kingdom to the operation of equipment to reduce moisture and to the formation of pellets which will remain discreet and not merge on contact with others.

6859 (CONF-8105173—, pp 24p, Paper 54) **Technology and costs of physical coal cleaning for controlling sulphur dioxide emissions.** Kilgroe, J.D.; Lagemann, R.C. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

There are over 460 coal cleaning plants in the United States which can handle over 360 million Mg of raw coal per year. The principal physical coal cleaning processes used today are oriented toward product standardization and ash reduction. Although coal cleaning plants are not designed for sulphur removal, it is estimated that commercially operating plants reduce the potential annual sulfur dioxide (SO_2) emissions from coal combustion by more than 1.6 million Mg. This is approximately 10 percent of the SO_2 emitted from combustion of high sulfur coal in the eastern United States. Coal contains organic and pyritic sulfur. The pyritic sulfur can be removed by crushing raw coal and by separating the heavier pyritic particles from the mixture by techniques which rely on the relative density or surface properties of the particles. The amount of sulfur which can be removed depends on the distinct properties of each type of coal and the cleaning techniques used. The desulphurization potential of United States coals varies between coal regions, and between coal beds in each region. The coals of each state have a different sulfur distribution and cleaning potential. Coal cleaning can remove from 30 to more than 40 percent of the total sulfur from high sulfur coals. Emissions from the combustion of washed high sulfur coals may range from approximately 430 to 860 ng SO_2/J. Cleaning low sulfur coals for SO_2 emission control may not be cost effective. The capital costs of coal cleaning range from $5 to $15 million. Annual operating costs range from $2 to $11 per Mg. The annual costs are about 50% lower than those for flue gas desulphurization (FGD). However, FGD removes 2 to 4 times more sulphur. For certain standards which cannot be met with low sulphur coals or coal cleaning, FGD or combinations of coal cleaning and FGD may be the most cost-effective SO_2 control technology.

6860 (CONF-8105173—, pp 7p, Paper 55) **Economics of the desulfurization of coal and flue gas in thermal power plants.** Jasicki, M.Z. 1981. (In French). NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

This paper deals with the economics of both coal and flue gas desulfurization, including energy losses and utilization of the mineral wastes in making sulfuric acid and as building materials and also regeneration of the adsorbent. The economics are calculated for each of these processes separately and together. For the particular case of this coal and the value of environmental protection, the least costly alternative involves coal desulfurization and utilization of the mineral wastes and no flue gas desulfurization. (LTN)

6861 **(DOE/NBM—3002756) Transport characteristics of alternate slurry fuels. Quarterly technical progress report, July-September 1982.** Joubert, J.I. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). 1982. 8p. NTIS, PC A02/MF A01. Order Number DE83002756.

Objective is to develop flow data for various alternate fuels, such as coal/water mixtures, in a pump loop which simulates fuel feed systems found in boiler and furnace applications. The program is primarily concerned with the measurements and correlation of pressure loss as a function of slurry characteristics and system design. The flow studies are being supported by laboratory studies. During this quarter, only a limited amount of experimental work was performed. A brief series of tests was conducted to evaluate the performance of the Sea-Vac pump, a centrifugal pump modified to reduce cavitation and operate at low net positive suction head or on two-phase systems. Modifications to the loop were begun.

6862 **(EPRI-CS—2309-Vol.2) Coal-oil mixture as a utility boiler fuel. Volume 2. Coal-oil mixture preparation. Final report.** Barbour, J.L.; Fleming, D.D.; Ghaly, O.F. (Atlantic Richfield Co., Harvey, IL (USA); Bechtel Group, Inc., San Francisco, CA (USA)). Nov 1982. 162p. NTIS, PC A08/MF A01. Order Number DE83900735.

Portions of document are illegible.

Atlantic Richfield Company, together with Bechtel Group, Inc. and Combustion Engineering, have conducted a study since August 1979 for the Electric Power Research Institute to: (1) develop guidelines for the electric utility industry to assess the technical and economic applicability of coal-oil mixtures (COM) to exist-

ing fossil fuel plants, and (2) assess the market potential and cost of preparation for a commercially produced COM fuel suitable for use by electric utility entities. This report is the compilation of work done for the second task. Results from Task 1 are reported separately. Reported here is a methodology for the estimation of coal-oil mixture pricing. Components included in the pricing estimate are raw materials costs, transportation and manufacturing cost components, with capital recovery treated according to both public (utility) and private financing guidelines. A detailed base case using a specific plant size, feedstock pricing, COM composition, and location assumptions was first developed. The component prices were then generalized to permit estimation of a COM price under any other specific circumstances. A 92,000 B/SD, 83,000 B/CD 50% oil/50% coal COM production plant in the Baltimore area was chosen for the study's base case because of potential economies of scale, that area's large use of imported oil, and the most favorable transportation situation. A slurry preparation process consisting of dry grinding, followed by mixing with No. 6 oil was chosen for detailed economic evaluation and preparation of a conceptual design because this is the most widely used commercial process. Because raw materials cost, including coal transportation to the plant site accounted for nearly 90% of the final delivered COM cost, a sensitivity analysis of the raw material component is also presented. 39 figures, 36 tables.

6863 **(VPI/CER—1-Bulletin) Coal flotation in inorganic salt solutions.** Yoon, R.H.; Sabey, J.B. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Center for Coal and Energy Research). Oct 1982. 119p. NTIS, PC A06/MF A01. Order Number DE83900500.

In the present work, the salt flotation technique has been tested with 27 different inorganic electrolytes on two high ash coal samples. The performance of various salt solutions were compared in terms of the separation efficiency. At an arbitrary concentration of 0.07 moles/liter, the best results were obtained with $CuSO_4$ at 68 percent separation efficiency. This may be compared with the separation efficiency of 61 percent obtained by the conventional flotation technique using both a frother and a collector. Other advantages of the salt flotation process are found in its improved sulfur rejection potential and its fast flotation kinetics. The frothability of salt solutions has been investigated as a function of concentration using double-distilled water. In general, the frothability of salt solutions increases with increasing surface tension of the solutions, contrary to what one might expect. A possible explanation for this is that bubble coalescence is hindered in the presence of electrolytes. The electrophoretic mobility of a bituminous coal sample has been measured as a function of pH in various salt solutions. It has been found that at 0.07 moles/liter, salts of trivalent cations reverse the mobility of coal from negative to positive, while salts of monovalent cations merely reduce the mobility due to double-layer compression. The most intriguing results have been obtained with salts of divalent cations; the coal samples exhibit zero mobility over wide ranges of pH. At the same time, the kinetics of salt flotation is best when these divalent salts are used. Contact angle and heat of immersion measurements have shown that the hydrophobicity of coal is not increased by the presence of electrolytes. The major role of the electrolytes is perhaps to reduce the zeta-potential around the coal particles, which facilitates the bubble-particle adhesion process. 33 figures, 10 tables.

6864 **Sixth international technical conference on slurry transportation. Proceedings.** Washington, DC; Slurry Transport Association (1981). 382p. (CONF-8103145—). Slurry Transport Association, 490 L'Enfant Plaza East, SW, Suite 3210, Washington, DC 20024.

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The Sixth International Technical Conference on Slurry Transportation was held at Las Vegas, Nevada, March 24-27, 1981. Researchers, engineers, economists and other specialists from Canada, Germany, Italy, Japan, the People's Republic of China. The Netherlands and the United States presented papers, which attracted some 500 registrants from around the world. This volume includes all of their papers plus other presentations made during the Conference, and a list of attendees. The Slurry Transport Association sponsors and conducts this annual series of Conferences as a significant part of its ongoing effort to foster the exchange of information about developments in the pipeline delivery of solid commodities. Proceedings of the earlier Conferences are available from STA, which is a non-profit corporation founded in the United States in 1975. Membership is open to all companies, organizations and individuals throughout the world who are involved in and/or interested in slurry transportation. Forty-one papers have been entered individually into EDB and ERA. (LTN)

6865 **Alton pipeline project and the Allen-Warner Valley energy system.** Arlidge, J.W. (Nevada Power Co., Las Vegas). pp 5-8 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

This paper outlines (1) the various components of the Allen-Warner Valley System; (2) provides some general details on the Alton Pipeline, a component of the Energy System; and (3) describes the status of the Energy System. The proposed Allen-Warner Valley Energy System will be composed of five major components. They are the Alton Coalfield near Kanab, Utah; the Warner Valley Station in Southern Utah near the City of St. George; the Harry Allen Station in Southern Nevada near Las Vegas; associated power transmission lines; and the Alton Pipe line, a coal slurry transportation pipeline. A breakdown of ownership of the proposed route of the Alton pipeline is quite interesting. Of the 183 miles, 78% or approximately 142 miles are public resource lands. Of the remaining 22%, 21 miles are state or county lands and 20 miles are private lands. The route requires the crossing of railroad rights-of-way in two locations. However, we were able to find locations where the railroads did not own the land in fee and thus could not block the pipeline route. Water for the slurry will be supplied from a deep (1100 to 1500) groundwater aquifer in the Navajo Sandstone Formation. The major facilities for the overall pipeline system are: coal slurry preparation plant, main pump station (located at preparation plant site), valve stations, terminal valves and pressure relief facilities (located at power stations), electrical substation (located at preparation plant site), communications facilities, maintenance facilities (located at preparation plant site), supervisory control facilities (located at preparation plant site), and airplane landing strips (located at preparation plant, valve station and power stations). We anticipate the cost of delivery of coal through the pipeline system will be approximately $6 to $9/ton based on an overall construction cost of about $270 million. These prices are based on 1986 dollars.

6866 **Pacific bulk transportation system.** Kopeikin, L.I. (BE & C Engineers, Inc., Tukwila, WA). pp 9-11 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Our system concept consists of a slurry pipeline whose head end is near the town of Emery, Utah, and which terminates at the City of Oxnard, California. At Oxnard coal is loaded hydraulically onto very large bulk carriers for transport to Far Eastern markets. Although substantial dewatering takes place prior to ship departure, the ship system is designed for simplicity to ensure rapid, reliable, and low-cost loading. Coal preparation takes place at the mine-mouth and slurry is delivered to the end of the pipeline by means of relatively short pipeline feeder segments. At the head end of the pipeline coal from various sources is accumulated and introduced into the system at 1200 psi. Pumping stations along the route provides sufficient head to overcome frictional losses and the rugged, mountainous terrain that is characteristic in the West. At Oxnard the slurry is dumped into settling ponds where excess water is decanted and then processed in a water treatment plant for local use. Some water is retained in a pond for reclaiming the slurry when a ship arrives for loading. At that time the coal is reslurried and pumped on board the ship where dewatering takes place. Shiploading and dewatering sequences are designed such that the vessel is ready to leave in 48 hours, which is approximately the time that loading alone would require. When the ship arrives at its destination the coal on board is reslurried with water from shore and the slurry is pumped into settling ponds similar to those in the United

States. Distribution within the recipient country is by pipeline or by coastal pusher barges. It is imperative that Japan, and the other countries of the Far East who are so heavily dependent upon oil, move to secure an economical supply of coal. Since customer commitment is all that is presently standing in the way of progress for BPAC development we would most certainly welcome such a commitment.

6867 **Northwest Pipeline Corporation.** Hayes, E.R. (Northwest Pipeline Corp., Salt Lake City, UT). pp 12-13 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

In 1975, John G. McMillian, President of Northwest Pipeline Corporation, initiated a coal slurry pipeline project as a natural extension of the company's energy transportation business. As it turned out, the project was not feasible at that time because the demand for coal in the Pacific Northwest was too small to support an economically sized slurry pipeline. The corporate interest was substantially rekindled during 1980 when the company began to study the possibility of establishing a major high Btu coal gasification plant near Boardman, Oregon. We anticipate that Far Eastern countries could become importers of from 10 to 15 million tons per year of coal that would be delivered by a slurry pipeline to a port near the mouth of the Columbia River by 1990. We are endeavoring to develop an overall coal movement for the NICES slurry transport system of from 25 to 35 million tons per year. At the 25 million ton per year level we would construct a 38″ diameter pipeline and at the 35 million ton per year level, a 42″ pipeline. The 38″ pipeline, which is our base case, would involve an investment of from $1.5 to $2.0 billion in 1980 dollars. The route of the pipeline across Southern Wyoming would facilitate economical construction of laterals to Northwestern Colorado and to Southwestern Wyoming coal fields where high Btu coal could be collected.

6868 **San Marco Pipeline Company 1980 status report.** Gillaspie, M.W. (Houston Natural Gas Corp., Houston, TX). pp 14 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

San Marco Pipeline Company is jointly owned by Houston Natural Gas Corporation and Rio Grande Industries, the parent company of the Denver & Rio Grande Western Railroad. Our concept includes the use of their rail system as a coal gathering network to collect the coal at a slurry preparation facility at Walsenburg, near the Southeast corner of Colorado. The planned capacity of the slurry pipeline system is 10 million tons of coal per year. The length of the proposed pipeline is approximately 900 miles of 24″ pipe to the first delivery point and 20″ pipe to the terminus of the line, which will be located in the vicinity of Houston, on the intracoastal water way, giving us access to barge transportation. It is our opinion that with the right of eminent domain bills that were passed in Texas and Oklahoma in 1978, we have the ability to obtain our right of way through condemnations, if necessary. We feel this is one hurdle that is mostly behind us. If, however, the water hurdle was also behind us a discussion of the market for our coal delivery would be more specific and we could be more definite about the timing of the market. So I will be general. The need for more coal consumption in place of oil and natural gas was apparent when we last met. The drastic increases in the price of gas and oil and the effect of these increases on the economy of our country now dramatize more than ever the need to switch to coal. It is also equally apparent that the transportation of this coal has a direct bearing upon the willingness of industrial users and utilities to make this switch. The need to convert to coal and the need for a dependable economic coal transportation system to compete with the railroads gives us confidence that the market will exist for our services when we can provide them. Acquisition of a usable water supply is presently occupying our efforts to further our project.

6869 **Progress report on the ETSI coal slurry pipeline.** Wasp, E.J. (Energy Transportation Systems Inc., San Francisco, CA). pp 15-19 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

After several years of litigation, and at considerable expense, we have effectively overcome railroad opposition to the project by acquiring, through the courts, the right to cross under rail tracks wherever we need to. Early this year we began acquiring non-railroad open field right-of-way, an activity we expect to complete by mid-1982. To be sure, it has taken us much longer than we ever thought possible to get this far, due to the opposition of the railroads. It has been a very expensive and high risk business. To date, the ETSI partners have funded our development phase at a cost of more than $30 million. Additionally, the ETSI partners have just committed to complete the next stage, that is, the definitive phase, of the project which will require additional outlays of money before we even break the first ground for the ultimate $2 billion system. We really believe in this project and in the eventual development of a substantial coal slurry industry in the United States. We will continue to persist as we hold to our objective of starting construction in 1983, and having the system in operation by 1985.

6870 **Coalstream pipeline status.** Dorris, A.D. (Continental Resources Co., Winter Park, FL). pp 20-21 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

In addition to the work on legislation, the year was spent updating and expanding the feasibility study of our project. The most likely case is shown in Figure 1. This system would gather coal in both the Appalachian and Illinois Basin coal fields and transport it to about 16 power plants in Georgia and Florida. The coal requirements of these plants exceed 50 million tons per year. The system, which is about 1500 miles long, would cost about 3 billion dollars if it could be built today. If built for start-up in 1988, it is estimated to cost about 5 billion dollars. Just recently a rail rate study was completed for us by A.T. Kearney, Inc. This study's purpose is to project the rail rates permissible under the rail deregulation (Staggers Act and to compare these rates with the pipeline tariffs. The overwhelmingly favorable rates by pipeline are obvious. A study has also begun on the feasibility of exporting coal slurry from the pipeline through a single point mooring much as discussed in the Boeing study. Another important piece of work this year was the formation and operation of a Utility Technical Advisory Committee. This committee is composed of engineering and operating people from the utility companies and engineers from the engineering consultant firm. Fluor Ocean Services, Inc., and our own company. The interchange of ideas and information through the functioning of this committee assures that all three groups are working with the same information and goals. We now feel that there is no doubt that a coal pipeline will be built to the Southeast-the only remaining question is when it will be built.

6871 **From Reynolds to Wasp: development of an industry.** Thompson, T.L. (Pipelines Systems, Inc., Orinda, CA). pp 23-40 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

This paper contains a short description of the contributions of each of the following to slurry pipeline technology: Osborne Reynolds, Wallace C. Andrews (ideas and patents), Robert L. Durand, Edward J. Wasp, Albert Einstein and Richard W. Hanks. (LTN)

6872 Thirteen years of operating experience with the world's first long-distance iron ore slurry pipeline. Bell, R.W.; Basso, J.A. (Pickands Mather & Co., Cleveland, OH). pp 41-44 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Savage River Mines is an iron ore mining and pelletizing operation located in the northwest section of the island state of Tasmania, Australia. The operation was designed to process the low-grade magnetite deposits at Savage River, where the ore is mined and concentrated. The concentrate is then transported in a slurry form via pipeline to Port Latta on the northwest coast, about 53 miles north of the mine site. Here the concentrate is pelletized and shipped to various consumers located principally in Japan. Based on previous experience in pumping similar material at the Pickands Mather-managed Erie Mining Company in Minnesota, Pickands Mather conceived the idea of utilizing a long-distance slurry pipeline to transport the iron ore concentrate from Savage River to Port Latta. The Savage River pipeline has now operated successfully for over 13 years. At the end of 1980, over 27 million tons of concentrate had been transported by this pipeline system. Improvements in operation and maintenance methods have been significant in achieving this success. The 53-mile long pipeline has a single pump station located 1100 feet above sea level in the concentrator at Savage River, and uses 9 inch pipe which is buried for most of the route. The line's highest point is 1750 feet and the discharge end is at sea level. It is designed to pump 2,500,000 tons of concentrate per year at 60% solids by weight and a velocity of 5.5 feet per second. The discharge pressure is between 1600 and 1900 psi and system availability is 88%. The concentrate contains a maximum of 5% + 200 mesh material. The pipeline system's major components are concentrate storage facilities and the pump station, the pipeline, and concentrate receiving facilities at Port Latta. The pipeline has a maximum slope of 10% (the critical slope is approximately 14%) which prevents the slurry from sliding downhill and filling the pipeline during a shutdown.

6873 Slurry pipeline experience in the Florida phosphate industry. Cross, F.; Tessitore, J. (Cross/Tessitore and Assoc., P.A., Orlando, FL). pp 45-51 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Most matrix slurry line operating and maintenance problems are due to pump malfunction and excessive pipe wear. Most pump malfunctions are due to cavitation which occurs because of improper spacing and start up at the slurry pit sump. Many of these problems have been corrected using variable speed pumps, control of liquid level in surge tanks ahead of pumps, and by operating procedures during slurry pit start up. Plugging of the slurry pipeline has also been experienced due to low velocity of the slurry causing heavier particles to settle in the bottom of the pipe. The main cause of this type of problem appears to be the uncertainty of slurry properties due to large variations in phosphate matrix during the mining procedure. Typically, matrix ore in some areas may be exclusively pebble and then suddenly shift to concentrate. Also the quantity of clay and/or sand may change for different matrix ore zones. Again, the use of variable speed pumps has eliminated some of the problems due to uncertainty of slurry properties. Also, the industry has established close controls on slurry pit operations to compensate for excessive variations in slurry properties. Due to the abrasiveness of the matrix slurry and the high velocity, pipe wear is a critical problem in the phosphate industry. The life expectancy of steel pipe has been between 24 and 36 months, depending on the nature of the matrix ore. To achieve this life expectancy, which is equivalent to 6 to 10 million cubic yards of coarse matrix, pipeline rotation is required every 2 to 3 million cubic yards of matrix. Pipeline rotation has proven successful, because most pipe wear occurs in the bottom of the pipe. Once a matrix slurry pipe can no longer be rotated, it is transferred for use in such activities as sand tailings, colloidal clays, and/or water transport.

6874 Coarse coal systems for unloading ships and overland transport. Kakka, R.S. (IHC Holland NV, Kinderdijk, Holland). pp 57-71 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

An interesting concept for unloading a large vessel by handling of bulk solids in slurry form is presented. The handling of coal in the terminal and transporting it by slurry method is attractive for power utilities. Economics favors pipelining compared with conventional systems if the slurry is suitable and if the transport is over short to medium distances. Most of the equipments needed for the construction of such a terminal are available. The design and construction of the terminal must integrate the technologies of slurry and conventional material handling. For the purpose of commercial acceptance of the slurry terminal and the slurry transport system, large scale tests will be needed.

6875 Coarse particle slurries and their use with offshore terminals to load bulk carriers. Funk, E.D.; Barrett, M.D. (Kamyr, Inc., Glens Falls, NY). pp 72-80 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

We have evaluated the direct discharge of coal and water into an existing ship hold versus dewatering along side of the ship. Direct discharge of water and coal into the ship is possible. We think that attempting to drain water from the hold while the loading is occurring will require large screens in the bottom of the hold. The flowing of water through a coal mass will cause flushing of fine coal to the screens. Many fines will pass the screens and be recycled to shore. It is possible that migration of fines to the screens will cause plugging of the screens. The screens could however be shut during loading and allow the coal to decant while stripping water from the top of the hold. After the hold is filled, the screens can be opened to allow a slow natural drainage. Such a decanting and drainage scheme is highly feasible. The ship must be designed for this type of operation. Additional storage of water is required on shore to provide the amounts needed to fill the hold. For existing ships, it is more feasible to mount small screens to accept dripping water from coal that has been preliminarily dewatered along side of the ship. The dewatering equipment can be installed in a barge that is connected to a mooring by floating hoses. The floating hoses allow the barge to be winched along the collier ship for filling of the holds.

6876 Deep ocean mining of manganese nodules: fluid-flow transport and hardware feasibility analysis. Vega, L.A. (Gianotti & Associates, Inc., Berkeley, CA). pp 81-99 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The design of a cost effective system for the fluid-flow transport of manganese nodules from the bottom of the ocean to an ore processing plant is one of the controlling elements in the technical development of a commercial deep ocean mining system. The system components, their operational characteristics, arrangement and type should be defined through an iterative feedback process among fluid-flow transport feasibility analysis; hardware feasibility analysis; and system(s) design and testing. Engineering models of the hydraulic and pneumatic transport of nodules are established from the analysis of the steady state fully developed vertical flow of liquid-solid and liquid-solid-gas mixtures, respectively. Fluid power requirements are predicted and compared to small and large scale land-based published experimental results. Subsequently, hardware requirements are established and existing equipment assessed for both fluid-flow modes of transport under consideration.

6877 **Rheological and hydromechanical investigations into the behavior of coking coal suspensions transported in pipelines.** Klose, R.B. (Stahlwerke, Peine-Salzgitter, West Germany). pp 100-104 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Coking-coal from three different mines were tested. Firstly, the coking-coal were prepared to the same size distribution ready for the tests. The hydraulic parameters for this particle size distribution are shown in Figure 2. The critical velocity as a function of the concentration clearly shows that the three coal/water mixes, are suspensions with different rheological behavior. The seam is a major factor in determining a grain's susceptibility to abrasion, during hydraulic transportation. A reason for this behavior can be found in the hardness of the coal and in its maceral composition. The investigations carried out alongside the hydraulic transportation tests, covered changes in the size distribution, changes of density within the individual fractions, changes in the maceral composition of the grain fractions, changes in the specific surface and in the flow characteristics. Investigations were also made into the effects on the coal's coking properties and on the transport water. The dewatering behavior was investigated on an industrial scale, as was the coking behavior in industrial-sized test ovens. Following a simulated hydraulic test-run of 250 km at the pilot plant, the extensive investigations showed that it is possible to carry out mechanical dewatering of the system, and that pipelining does not affect the quality of the coke.

6878 **Rheology: based correlation for minimum deposition velocities.** Hanks, R.W.; Sloan, D.G. (Brigham Young Univ., Provo, UT). pp 107-120 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

One of the most important design parameters for the transport of mixed size fraction pseudohomogeneous and heterogeneous slurries is the minimum deposition velocity. It has previously been shown that a clearcut need exists for an improved correlation which is capable of accounting for the influence of both rheology and particle dynamics as well as particle size, density, pipe diameter and concentration on the prediction of the minimum deposition velocity. In this paper we present a completely new model for the correlation of V/sub DC/, the critical or minimum deposition velocity. This model introduces for the first time both rheological (hydrodynamic) effects and particle dynamic effects. It accounts properly for the effect of fluid viscosity in Newtonian slurries. It accounts properly for the effects of both fluid and solid density for a range of solids from coal to iron ore. It properly predicts dependence upon particle size and upon pipe diameter. It further permits predictions of the influence of Bingham plastic (or any other) rheology on V/sub DC/. In all comparisons with existing literature data covering wide ranges of variables the present model equals or far exceeds the degree of goodness of fit of any previous correlations and is shown to be the only model in existence capable of correctly correlating all variables for all the available data used to test the correlations. Although this model is derived here only for uniform sized particles, it represents a major step in the direction of developing a more general correlation to account for mixed particle size distribution slurries from the real world of commercial solids pipeline transport. 52 references.

6879 **Pulsing flows of clay suspensions.** Round, G.F.; Hameed, A.; Latto, B. (McMaster Univ., Hamilton, Ontario, Canada). pp 121-130 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The concept of increasing the volumetric flowrate of certain fluids in pipelines by superimposing an oscillating component upon a steady flow, has been reported extensively in the literature. In this particular paper, we are concerned with both the theoretical possibility of increasing volumetric throughput by pulsation of viscoelastic fluids and experimental confirmation of this with a study of clay-water suspensions. It has been shown by a number of investigators that there is no energy advantage to be gained by superposing pulsations upon Newtonian fluids. The reason for this is that the time-averaged volumetric flowrate, anti Q is equal to zero for purely oscillatory flow. The case of non-Newtonian fluids, however, is considerably different and in this paper we concentrate upon the flows of non-Newtonian fluids with specific reference to those fluids exhibiting Bingham plastic behavior. Based upon the experiments so far, the following conclusions may be drawn: (1) there is the possibility of hydraulic power saving in flowing pulsing flows versus steady flows at the same flowrate for viscoelastic Bingham-type fluids; (2) there are both frequencies and amplitudes at which the ratio of (J/sub p//J/sub s/) achieves a minimum; (3) the equation for the laminar oscillatory flow of an ideal Bingham plastic predicts the existence of a peak in the velocity which is larger than the Newtonian fluid and curves further away from the pipe axis; (4) this equation, when superposed upon the steady flow of the Bingham plastic slurry (Buckingham equation), predicts an increase in flowrate at the same mean pressure gradient compared with that for steady state.

6880 **Theoretical considerations and laboratory investigations about water hammer propagation velocity in slurry pipelines.** Bechteler, W.; Vogel, G. (Hochschule der Bundeswehr, Munchen, Germany). pp 131-137 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

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Pressure wave velocity is the outstanding factor in calculating pressure rises due to sudden changes of flow. For the case of single-phase flows, a generally accepted equation is at hand to compute this velocity. On the contrary, there are three equations available for two-phase flows; two of them with the understanding of fully suspended particles, the third one for the settled bed case. These equations are assessed theoretically and compared to experimental results. The tests performed used water as the carrier fluid and quartz sand and hard coal for the solids phase. In a pipeline with differing lengths of 35 m, 60 m and 115 m and an internal diameter of 5.1 cm, concentrations up to 40% of volume were investigated. From the theoretical point of view both equations (1) and (2) are acceptable. The basic assumptions, however, have to be kept in mind. For Eq. (1) they include the possibility of the two phases to move separately (V/sub S/ not equal to V/sub F/), for Eq. (2) no difference of flow velocities is allowed. The evaluation of recorded data shows a discrepancy of less than 3% between the theoretical clear water value (1360 m/s) and any slurry concentration investigated (1350 to 1390 m/s). Looking at the fact that Eq. (1) predicts greater values than the ones measured (sand slurry) and that its assumption is fulfilled because of the particle sizes we used, it should be preferred to Eq. (2). Eq. (3) has not been found to describe the settled bed condition in a satisfying way, neither by theory nor by experiment. Wave velocities under this condition were found to be pressure- and time-dependent, because of the inevitable presence of air in a mixture. This air will always have an attenuating and therefore beneficial effect on pressure heights and velocities and is under no circumstances a danger for the line.

6881 **Abrasive wear of centrifugal slurry pumps.** Faddick, R.R. (Colorado School of Mines, Golden); Studebaker, J. pp 145-155 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The purpose of the pump wear test program was to study the basic laws of abrasion on centrifugal slurry pumps. Specifically, erosive wear was examined on pump impellers, follower plates and casing while pumping a fixed concentration of a particular river sand over a range of flowrate and runner speeds. Based upon the data analyzed the following conclusions are drawn: The ten Meehanite impellers wore in a uniform pattern suggesting that the designed pump geometry was conducive to good hydraulic and wear performance. Impeller wear was defined in general terms by weight loss rather than on a local basis by thickness loss. Absolute weight

loss was found to vary with solids tonnage to the 0.83 power whereas theory suggested an exponent of unity. A power law model represented the data better than an exponential model. Wear life varies as the -2.1 power of the impeller speed, whereas theory suggests an exponent of -2.0. Wear rate varies as the 2.3 power of the impeller speed, whereas theory suggests an exponent of 2.0. Specific wear varies as the 2.8 power of the impeller speed, whereas theory suggests an exponent of 3.0. Discharge pressure as read on a Bowdon gauge appears to be an expedient but limited means of monitoring pump wear.

6882 **Economics of positive displacement slurry pumps.** Holthuis, C.H.; Simons, P.W.H. (Holthuis B.V., Grubbenvorsterweg, Netherlands). pp 156-161 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

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This paper deals with Positive Displacement Pumps used for long-distance slurry pipelines. An economic comparison is made between the available piston pumps, plunger pumps and diaphragm pumps with regard to wear, operating costs and availability. Piston pumps are used on coal slurry pipeline transportation. The paper shows that triplex single-acting piston pumps offer considerable advantages over duplex double-acting piston pumps. A comparison is drawn between plunger pumps and diaphragm pumps used for pumping very abrasive slurries, such as ore concentrates and tailings. The comparison between plunger pumps and diaphragm pumps shows that low-speed diaphragm pumps up to a max. speed of 50 strokes per minute are preferred because of their very low operating costs and high availability, even in the case of relatively high capital investment. For the handling of very abrasive slurries such as ore concentrates, tailings, etc., a mechanical separation of the slurry and working parts of the pump by means of diaphragms, as featured by the GEHO diaphragm pump, is ideal. The diaphragm pump has the lowest number of wearing parts, thus considerably reducing operating costs and ensuring maximum availability.

6883 **Slurry pump and pipeline performance testing at the Georgia Iron Works Hydraulic Laboratory.** Addie, G.R. (Georgia Iron Works Co., Grovetown). pp 162-183 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The GIW Hydraulic Laboratory is one of the largest and most sophisticated labs of its type in the world. With multiple slurry test loop systems, a wide variety of instrumentation, and a unique multi channel, extremely flexible and high speed system of monitoring, displaying, and storing data. The GIW Hydraulic Laboratory is set up to carry out both pump and pipeline performance testing on water and slurry. Three test loop sizes of 4", 8" and 18" diameter pipeline are available for open sump pump head quantity or pipeline tests using water or slurry. The data acquisition system is described in detail and data analysis methods are illustrated by several graphs of test results.

6884 **Valve design for slurry systems.** Patton, A.J. (Gulf + Western Manufacturing, Co., Warwick, RI). pp 184-187 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Continued interest in slurry transport systems, including process applications, presents challenges in the design of system components such as valves. Design parameters traditionally considered for single phase flow must be addressed as well as those unique to slurry service. Particular efforts are being undertaken in material selection for abrasion/corrosion resistance. Current research involves the evaluation of using carbon steel components that have been coated with tungsten-titanium compounds applied by the diffusion process. If successful, this combination may be the alternative to using stainless steel components that are subject to stress corrosion cracking in high temperature operations. Ever increasing concern over pipeline leaks and major breaks will mean more stringent valve system requirements. Slurry system designers should take advantage of the knowledge and background developed by the nuclear industry, particularly in the area of seismic qualification of valve and valve operators. Requirements for reliable pipeline isolation valves in both new transport system process applications will require this expertise. The ball valve used for isolation or block application has advantages of simplicity of design, leak tight sealing, low torque requirements, low pressure drop, and ease of disassembly and maintenance. Additionally, the valve is capable of three-second or less closure when supplied with certain operators (actuators) that are commercially available. The basic design can be provided with soft seat materials such as Buna N and fluorocarbon rubber for low temperature slurry transport systems.

6885 **Photogrammetry: an aid in location and design.** Harron, W.J. (Bovay Engineers, Inc., Albuquerque, NM). pp 191-197 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The utilization of aerial photography, photo interpretative and photogrammetric techniques in the planning, location, and design of cross-country lines is reviewed.

6886 **ETSI coal evaluation plant.** Derammelaere, R.H; Wasp, E.J. (Energy Transportation Systems, Inc., San Francisco, CA). pp 198-204 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

More technical effort was spent on the dewatering process than any other part of the ETSI system. This was dictated by the shortcomings in the Eastlake and Mohave dewatering systems and by stricter environmental limitations on gaseous emissions and effluents. The dewatering process developed by ETSI included: thorough investigation of the process and performance of the Eastlake and Mohave dewatering plants; state-of-the-art investigation of commercially proven dewatering equipment; laboratory-scale vendor test program on selected dewatering equipment; and pilot plant tests demonstrating the technical and economic feasibility of the primary components of the selected process (screen-bowl centrifuges followed by vibrating bed dryers). This work led to the process adapted by ETSI for the design of its commercial dewatering plants now patented by E.J. Wasp (No. 3867109). However, one more step is planned by ETSI before building its plants; this is the construction and operation of a coal evaluation plant (CEP). The 50 ton-per-hour dewatering facility will use commercial screen-bowl centrifuges and vibrating bed dryers. The facility's purpose is to fine-tune process variables and assess the impact that varying coal characteristics have on such fine-tuning. The CEP will be the ultimate demonstration that coal slurry can be dewatered to a specification 10% surface moisture on a consistent and economic basis and that the dried pipeline coal can be handled and stored in a conventional way without creating dust problems. A good portion of this paper is devoted to the CEP design, objectives, and schedule.

6887 **Coal oil mixture firing direct from slurry transported coal.** Forney, R. (Stearns-Roger, Denver, CO). pp 213-217 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Florida has enjoyed the convenience of liquid and gaseous utility fuels for many years now, but its future energy source will be coal. With only 20% of their present electric power generated by coal, the citizens of Florida have new experiences to look forward to. With modern power plant technology there will be little impact on the citizens of Florida from the burning of coal. The greatest dislocation may well be the transportation of coal through Florida to the individual power stations. The available transportation alternatives to Florida are railroads, barges and slurry pipelines. Each of these transportation modes have their own advan-

tages and disadvantages, depending upon the unique circumstances of the power station and the supplying coal mine. Traditionally, coal would have arrived in Florida by rail or barge, but the advent of coal slurry pipelines has increased the available options. Today Florida utilities are seriously considering moving fifty million tons of coal annually to multiple power stations throughout the state. The purpose of this paper is to discuss several significant factors, which can impact Florida's coal slurry pipeline decision. The starting date of a coal slurry pipeline into Florida can have a serious influence on the socioeconomic infrastructure of Florida and some communities in particular. It is concluded that there is no coal transport system into Florida, which is totally void of any problems, but the coal slurry pipeline delivery mode has by far the greatest number of advantages with the least number of disadvantages.

6888 **Effluent characteristics and discharge permit considerations for the ETSI coal slurry pipeline.** Plummer, A.H. Jr. (Alan Plummer and Associates, Inc., Arlington, TX); Derammelaere, R.H.; Eiserman, F.M. pp 255-265 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

ETSI has examined the characteristics of simulated dewatering plant wastewater in order to project the water quality characteristics of the wastewater from the proposed commercial coal dewatering facilities. The results of these simulation studies indicate that the characteristics of both the transport water and of the coal contribute to the highly variable quality characteristics of the wastewater. The minerals (TDS, SO_4, and Cl) observed in the coal slurry wastewater were present at levels that would not generally result in a violation of receiving stream standards. The BOD levels of the wastewater would not result in a violation of stream dissolved oxygen standards. However, to be consistent with state and federal policies, biological treatment will be applied to reduce the BOD levels. Data developed through the performance of simulation studies using the coal and water to be transported by the ETSI coal slurry pipeline project indicate that the coal slurry wastewater will contain extremely low concentrations of some metals. These concentrations are, however, considerably lower than applicable state and federal regulations. These studies further indicate that the coal slurry wastewater will not contain other materials classified as priority pollutants. Results of ETSI studies indicate that the projected discharges from the proposed dewatering facilities would not result in reductions of the beneficial use classifications of the receiving streams. The major treatment requirement will be reduction of BOD by biological treatment to levels consistent with state and federal requirements.

6889 **Coal transportation: an analysis of cost and energy requirements.** Prassone, M. (Italimpianti, Genova, Italy); Testa, G.; Ferrini, F.; Foramitti, E.; Simonetti, F.; Giacomazzi, G.; Montellanico, P. pp 266-277 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

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By jointly examining the results obtained for both the cost and energy analysis, some additional aspects can be pointed out in the comparison between the two transportation systems. The diagram presented allows us to distinguish between different regions of convenience. All points below the break-even lines are convenient for unit train transportation and, of course, regions above such lines represent fields of convenience for pipelines. When the economical and energetic lines intersect each other it is possible to characterize new aspects of convenience. For example, considering the break-even line relevant to a 30% new line and 70% upgraded railroad and the energy line, it is possible to detemine 4 different regions. The area below both the energy and cost lines means convenience for unit trains from both points of view. The area above both energy and cost lines means convenience for pipelines from both points of view. The area above the energy line and below the economic one means only energy convenience for pipelines. The areas above the economic line and below the energy one means only economic convenience for pipelines. In other words a new field of convenience for pipelines is found when an investor is energy sensitive and arrives at incresingly responsible investment by keeping an eye on the future energy scenario. When railroad conditions imply the construction of a completely new line or of large sections of new line, the economic convenience of pipelines is reached for decreasing lengths (e.g. for a 100% new rail line, pipeline is always convenient for lengths exceeding approximately 300 Km), but from an energy point of view the breakeven length is somewhat higher. Anyway it must be pointed out that most of the proposed coal slurry pipeline systems, already proved to be economically viable, are also convenient from the energy point of view.

6890 **Economic optimum design of a methacoal pipeline.** Qureshi, A.; Darby, R. (Texas A & M Univ., College Station). pp 278-288 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

From the results obtained and described, the following conclusions can be drawn: (1) The rheological model used to describe the methacoal suspension non-Newtonian properties is important, especially if the pipeline conditions do not coincide with laboratory conditions used to obtain the rheological data. (2) The friction factor correlation used to determine pressure drop is also important. (3) The optimum transportation cost for a two way pipeline with methanol recycle is about 1.4 cents ton-mile, compared with 0.99 cents/ton-mile for a one way line, or a 45% increase due to the inclusion of the methanol recycle line (which includes the inventory cost of methanol in the pipeline. (4) The optimum suspension velocity for the one way pipeline lies in the turbulent region, whereas it is in the transition region in the case of the two way line with recycle. (5) The optimum solids loading is higher (0.55 weight fraction) for the two way line than for the one way line (0.46 weight fraction). (6) The tariff cost exhibits a minimum at a specific fraction of fines (below 30 μm), which is lower for the one way line than for the two way line. (7) The total cost decreases with pipeline length up to 1500 miles but tends to level off at the point. (8) The cost decreases with increase in the coal throughput rate but at a faster rate below 25 x 10^6 tons/year than above this value. (9) The optimum number of pump stations, and the optimum pump discharge, is higher for the two way line than for the one way line. (10) Telescoping the pipe wall results in a significant savings if the number of stations is at or below the optimum number. The savings is about 13% for the two way line, and 19% for the one way line.

6891 **Expediting the licensing procedure for a slurry transport project.** Hartman, R.M.; Cooper, R.J. (Envirosphere Co., Atlanta/Norcross, GA). pp 291-295 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The purpose of this paper is to analyze current shortcomings that exist in the comprehensive licensing of large and complex energy facilities in general and coal slurry pipelines in particular, and to offer recommendations to improve the licensing process. For approximately 10 years, government and industry have both realized that a rather illogical process in licensing major energy facilities has evolved. At the heart of this problem lies the fact that, for over 20 years, the US Congress and state legislatures have passed many separate laws protecting public health and safety and preserving the natural environment. As a result of such piece-meal legislation, jurisdiction on these matters lies with many different federal and state agencies. Thus, a typical proposed energy facility may require five or six different federal permits and an equal or greater number of state and local permits. This, of course, does not include review by the 15 to 30 other regulatory agencies that input to the various permitting agencies. Information required of the applicants by various agencies is very often duplicative in nature, yet analyses of this information can lead to conflicting decisions because various agency responsibilities can be quite different from one another. For example, an agency charged with responsibilities for air quality matters may focus more on the removal of material from plant stacks, in turn resulting in greater solid waste disposal problems.

6892 **Relationships in the siting of power plants, slurry pipelines, unit trains and other energy transportation.** West, L.B. Jr.; Tauxe, G.W. (Univ. of Oklahoma, Norman). pp 296-303 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

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A systems approach of the transportation and siting issues is presented in this paper which provides a matrix of the factors involved in the conversion of coal at some remote location to electricity delivered at a demand point. Various parameters and the interaction of them are discussed in economic, social and environmental matrices. The conversion of energy from coal at a remote site to electricity in your wall plug is a complex and highly technical task. The problem of transporting coal and siting power plants is high dependent on economic, environmental, and social variables which are only partially under the control of any of the system designers. Many of the factors herein will prove to be acceptable when they are considered as a single element of the overall configuration. However, when these factors are combined to provide a power transportation system, their interactions become very crucial and critical and can be used effectively to limit from further considerations those configurations which either cause the most undesirable social or environmental effects and/or, those that are constrained; lack of water availability, for example. Engineers, scientists, planners, and developers must remember that a specific project is not the complete system. The complete system entails examining the problems of water transfers, cross subsidization of transportation networks, political and social reactions caused by misunderstanding the problem or mistrust by politicians, power suppliers, coal miners, pipeline builders, railroad operators and analysts. A simple study of a singular project within the energy movement business does not provide the participant with the total picture. Energy movement from one area to another is a very complex problem which should be handled in a comprehensive manner with consideration given to its global nature.

6893 **Effects of coal slurry pipelining of eastern coal on water quality.** Moore, J.W. (Univ. of Arkansas, Fayetteville). pp 304-310 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The general water quality characteristics of slurry wastewaters are known. However, the dependence of slurry wastewater quality characteristics on both coal quality and water quality is such that laboratory investigations involving specific coal and water sources will be required for some time for the purposes of satisfying environmental requirements and for treatment plant design. Treatment requirements for wastewater resulting from the slurry pipelining of eastern coal will, almost certainly, be more stringent than for slurry wastewaters resulting from the pipelining of western coal. The concentrations of the contaminants present in slurries prepared with eastern coal are frequently much greater than in slurries prepared with western coal. The quality of water used for slurry formation may have a significant influence on slurry wastewater quality and must be considered in evaluating the overall treatment/disposal needs and environmental requirements. The general water quality parameters which are likely to be the most significant are suspended solids, dissolved solids, sulfate, and hardness. Heavy metals, chloride, and sodium may also be significant depending on site specific circumstances. Consideration should be given to the use of the slurry wastewater as part of the makeup water for the circulating water system at those termini where significant cooling water flows are used. Consideration of the water quality aspects of slurry pipelining should be included throughout the development of a coal slurry pipelining project. In this manner optimization of the total project can be obtained. Laboratory investigations should be conducted as early as possible using the specific coal and water sources to be utilized for a particular pipeline to allow inclusion of this aspect of coal slurry pipelining in the decision-making process.

6894 **Experimental study on pipe erosion by sand slurry.** Hisamitsu, N.; Iseh, T.; Honda, Y.; Takeishi, Y. (Sumitomo Metal Industries, Ltd., Osaka, Japan). pp 319-332 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The following information was obtained from the results of experiments on the influence of slurry velocity, pipe hardness, type of steel and bend curvature on the erosion of pipes. (1) Erosion of straight pipe: (a) The position of maximum erosion differs depending on the mode of flow. In the steady heterogeneous flow, the maximum erosion occurs at 45° up from the bottom of the pipe. In the unsteady heterogeneous flow or floating flow, the position of the maximum erosion is located in the bottom of the pipe. (b). The maximum erosion rate is directly proportional to $2.18 \approx 2.85$-th power of the slurry velocity and inversely proportional to hardness of the pipe. (c). When the hardness of the pipe is same, superiority in erosion resistance rises in order of heat-treated steel, non-heat-treated steel, low-alloy steel. (d). The maximum erosion rate can be estimated with errors within +-30% using expressions (2), (3), (6) and (7). (2) Erosion of bent pipe: (a). The position of maximum erosion occurs near the outlet of the bent pipe portion. (b) The maximum erosion rate is directly proportional to n-th power of the slurry velocity and this index n becomes larger with decrease of radius of curvature. (c). The maximum erosion rate of the carbon steel bent pipe in which the ratio of radius of curvature and inner diameter of the pipe is larger than 2 can be estimated by the expression (15) with errors within +-20%.

6895 **Pipeline material selection for transport of abrasive tailings.** Snoek, P.E.; Carney, J.C. (Bechtel Petroleum, Inc., San Francisco, CA). pp 333-339 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

This paper first discusses tailings characteristics and the desired pipeline system features for its transportation. Various alternative pipe materials are reviewed for both low and high pressure systems. The paper also discusses comparative wear tests and their relative advantages and disadvantages. There are several major features that are desired in any tailings pipeline system. The ranking is somewhat dependent upon the particular project conditions but a list would include the following: High operability factor, system integrity, proven installation, acceptable material delivery schedule, and minimum cost.

6896 **Energy loss reduction for heterogeneous flow of solid-liquid mixture in pipes with erosion wear bottom protection.** Li, Z.S. (Central Coal Mining Research Inst., People's Republic of China); Kao, D.T. pp 340-350 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

To protect a hydraulic transport line forom excessive erosion wear along the bottom portion of the pipe, the method of partial lining has been suggested. Such a practice will result in broadening the base area of the flow cross-section where the transverse solid concentration distribution is the highest. This in turn may help to improve the hydraulic transport efficiency of the system. The actual hydraulic behavior of the bottom lined pipe section was not, however, closely observed and fully understood. In the present study, a series of experimental tests were conducted in order to carry out an in depth investigation of the flow behavior in the hydraulic transport pipes protected with bottom lining. Specific attention was given to the energy loss relationship in circular and modified pipes carrying heterogeneous solid-liquid mixtures of the same solid concentration and transport rate. The results indicated that the suggested erosion wear protection method is an attractive one and has potential practical value. The modified pipes show distinctively higher hydraulic transport efficiency for largely heterogeneous mixture flow of high solid concentration. When all factors

are taken into consideration including, among others, the field applicability it became apparent that 10% area reduction is more suitable choice instead of 30% as recommended by previous researchers working on segment pipe problems. A considerable amount of experimental data is presented.

6897 **Hardened steel pipe provides longer life in wear areas of slurry transportation systems.** Bhargava, R.K.; Parrott, E.R. (Xtek, Inc., Cincinnati, OH). pp 351-356 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

Based on experience in several slurry pipeline installations, it is concluded that: (1) The predominant wear modes in a slurry line pipe are dependent on service conditions. (2) The hardness at the inside surface of the pipe along with the hardness across the pipe wall is the most important parameter for abrasive wear resistance. (3) The wear data collected from various actual service conditions indicated that Xtek 500 pipe has a superior wear resistance than the slurry pipes. (4) The Xtek 500 pipe, being a steel pipe, should be treated in exactly the same manner to protect against corrosive wear as a mild steel pipe.

6898 **Review of US coal slurry pipeline industry: why-why not.** Steffes, D.W. (Planning & Forecasting Consultants, Houston, TX). pp 359-366 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

This paper begins by explaining why the predictions for slurry pipelines in 1973 did not come to pass by 1980: (1) the coal industry has not developed nearly as fast as predicted (particularly production of western US coal) and (2) the ability of the railroads to haul the coal was underestimated. Railroads hauling coal have three kinds of competition: interfuel, intermodal and interregional. They must price against all three and, if all the market will bear is less than fully allocated costs, so be it as long as it is above variable cost. Finally, methodology recommendations are made for conducting feasibility studies for slurry pipelines with increasing detail and precision as the decision making time approaches. (LTN)

6899 **Maintenance of coal slurry dewatering equipment and the application of a Predix diagnostic system.** Halloran, J.J.; Smith, D.J. (Combustion Engineering, Inc., Windsor, CT). pp 369-379 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The largest coal slurry dewatering in operation is located at the Mohave Generating Station in Southpoint, Nevada. This 1580-megawatt power station is operated by Southern California Edison Company, the principal owner. Two 790-megawatt Combined Circulation steam generators supplied by Combustion Engineering, Inc., provide steam for the total station output. The unique feature of this station is that it is fed by a coal/water slurry, which is prepared by the Black Mesa Pipeline company and pumped 273 miles across Arizona and into the plant in Nevada. Implementation of the service center concept has played a key role in maximizing the availability of the coal processing equipment at this slurry-fired plant. The daily access to O.E.M. expertise has enhanced the ability to continually improve equipment service life and availability. This has been accomplished through expert supervision, product improvement, and development of sophisticated maintenance planning and scheduling techniques.

6900 **Transport of peat moss slurry in a pipeline.** Carncross, C.A. (Western Peat Moss Ltd., Vancouver, British Columbia). pp 107-109 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The operation of a peat slurry pipeline near Vancouver, British Columbia, is described. Peat is harvested using a hydraulic peat extraction method and conveyed from the bog to a dewatering plant. The slurry pump is described and a discussion of pumping thick slurries is presented. (DMC)

6901 **Peat dewatering.** Kopstein, M.J. (Dept. of Energy, Washington, DC). pp 139-143 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

Peat has a high affinity for water that is manifested by great difficulty in removing the water by conventional and mechanical solid-liquid separation techniques. Thermal drying may be employed to evaporate only a small fraction of the overall moisture content because of the adverse effect evaporation has on thermal efficiency and, hence, process economics. A technology must be developed for reducing the water content of peat from its level in the bogs (more than 85% moisture by weight) to provide an acceptable feed material for large-scale peat utilization. The commercial procedures for dewatering peat were developed - and are currently being employed - in Europe (Ireland, Finland, Sweden, West Germany, and Russia). The drying mechanisms are forced convection and solar radiation. Very large areas (as large as 400 square miles) would be required for a commercial-scale peat gasification plant. The procedures are overly dependent on the climate and often result in hard-to-contain fires in the peat bogs. For these reasons, the European milled peat and machine sod peat processes are not likely to be widely utilized in the United States. There are several promising peat dewatering research and development activities in the United States, Finland, and Sweden. These studies are developing and testing methods to overcome the fundamental peat-water attraction (hydrogen bonding, colloids, etc.).

0140 Combustion

REFER ALSO TO CITATION(S) 6727, 6742, 6813, 6815, 6887, 7267, 8153, 8155

6902 (CONF-8105173—, pp 7p, Paper 1) **Fluidized-bed combustion.** 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

This consolidated report and the available literature indicates that the subject of fluidized-bed combustion is being taken up by a number of European countries. Its advantages over conventional furnaces are: an opportunity to burn low-grade fuel and wastes with a low-combustible content and a low-combustion temperature, lower than in any other known process; a greater heat release rate in the furnace and a correspondingly greater heating capacity, for a smaller size and lower plant costs; and a broad range of furnace output regulation. The technique has been developed to such a point that it can be used on an industrial scale for boiler units with a capacity of 20 to 25 t per unit/hour. Larger plants are in operation only in isolated cases, and plants with a capacity greater than 100 MWt are still only in the early development stage. One extremely promising application of the technique is fluidized-bed combustion under high pressure. Preliminary tests show promise of increased fuel combustion efficiency. In view of the rapid development of and great promise shown by this new combustion technique, chiefly because it offers the possibility of using extremely low-quality fuel, the authors recommend that the Group of Experts should revert to this subject periodically. The report consolidates answers with respect to 27 topics from several countries.

6903 (CONF-8105173—, pp 16p, Paper 53) **Emissions during the pressurized fluidized bed combustion of coal.** Jansson, S.A. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Pressurized fluidized bed combustion (PFBC) of coal provides good desulphurization and very little formation of polycyclic organic matter, e.g. polyatomatic hydrocarbons (POM/PAH). Re-

sults from PFBC rig tests suggest that the nitrogen oxide level in the efflux decreases with increasing system pressure, and increases with the level of excess air in the combustion gases. It seems likely that nitrogen oxide emissions can be decreased from the 0.45 or 0.53 lbs NO/sub x//M BTU level experienced during a recent 1000 hour test to 0.10 or 0.15 lbs NO/sub x//M BTU if the excess air level is decreased around 20 to 30 percent, a value that is deemed acceptable also from other points of view in a fully optimized PFBC system. Thereby, a PFBC unit would compare very favorably even with boilers equipped with next generation low-NO/sub x/ burners. Leaching experiments, reported in the literature, suggest that PFBC waste leachates meet drinking water standards in all respects other than solids, pH, and calcium and sulphate.

6904 (CONF-8105173—, pp 17p, Paper 57) **Status of the fluidized bed combustion in the Federal Republic of Germany.** Batsch, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

A description of fluidized bed combustion (FBC) technology is given in the paper. In particular, the special features of atmospheric, pressurized and circulating fluidized-bed combustion are discussed. The advantages of these technologies are the following: low NO/sub x/ emissions; removal of SO_2 by the addition of limestone or dolomite (a flue-gas desulphurization plant is not required); space requirements less than for conventional plants; and low grade coal can be used. The advantages with respect to environmental protection and space requirements are reinforced by pressurized operation. In this case, thermal efficiency can be raised by combining the technique with a gas turbine. The concept of the circulating fluidized bed is characterized by a particularly low emission level, a favorable part load behavior and the possibility of realizing large units in one module. The paper describes research and development projects in the area of FBC which are being carried out in the Federal Republic of Germany. The status of development is also described. The costs of FBC systems are discussed qualitatively and compared to conventional systems.

6905 **(DOE/ET/17093—T6) Testing and verification of granular-bed filters for the removal of particulate and alkalies. Seventh quarterly project report, April 1-June 30, 1982.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1982. Contract AC21-80ET17093. 55p. NTIS, PC A04/MF A01. Order Number DE83003063.

Portions of document are illegible. Printed copy available until stock is exhausted.

The Westinghouse Electric Corporation with Ducon, Inc., and Burns and Roe, Inc. are conducting a test and evaluation program of a Granular Bed Filter (GFB) for gas cleaning applications in pressurized-fluidized bed combustion processes. This work is funded by DOE PRDA for Exploratory Research, Development, Testing and Evaluation of Systems or Devices for Hot Gas Cleanup. This report describes the status of the testing of the subpilot scale GBF unit under simulated pressurized-Fluidized Bed Combustion (PFBC) conditions through Phase II and test results and analysis from the on-going bench scale alkali gettering work.

6906 **Titanium as a tracer for determining coal burnout.** Pace, R.S.; Hedman, P.O.; Smoot, L.D. (Brigham Young Univ., Provo, UT). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 167-173(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Titanium can accurately be determined in char samples by using the internal standard method of XRF calibration. Errors of +-2 to 3% are incurred mostly from sample preparation inaccuracy. X-ray fluorescence instrument error is less than +-0.4%. Titanium compounds in ash are more stable than the total ash constituents and hence provide a solid phase tracer to complete overall mass balances with increased accuracy. Burnout calculations are improved by as much as 20% at burnout values less than 95% and with high ash loss. When coal burnout level is above 95%, titanium provides only 1 to 2 % increased accuracy in the burnout calculation. Use of the titanium tracer also provides a method of calculating ash loss. Up to 60% of the ash was lost in these combustion tests. This loss is the sum of the losses due to vaporization in the flame and dissolution into the quench water.

6907 **Bed agglomerates formed by atmospheric fluidized bed combustion of a North Dakota lignite.** Benson, S.A.; (Dept. of Energy, Grand Forks, ND); Karner, F.R.; Goblirsch, G.M.; Brekke, D.W. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 174-181(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

This paper discusses the performance of quartz or limestone as a bed material during the combustion of high sodium North Dakota lignite. The lignite is from the Beulah mine of Mercer County, North Dakota. The composite coal and coal ash analysis is summarized in Table 1. The lignite was partially dried before this series of tests; its as-mined moisture content was 36%, and its heating valve 15,000 J/g. Other important considerations are the operation of the combustor and how operational parameters affect the performance of the bed material, sulfur retention on coal ash and bed material, and heat transfer. The most important operational parameters of the AFBC for the tests are listed. The tendency for the bed to agglomerate has been shown through extensive testing to depend on the following parameters: (1) bed temperature (higher temperature increases tendency); (2) coal sodium content (increased coal sodium content shows increased severity of agglomeration); (3) bed material composition (high calcium content tends to delay, and decrease the severity of agglomerates formed; (4) ash recycle (increased recycle of ash tends to increase agglomeration tendency); (5) there appears to be a bed design parameter such as position of coal feed points, and distributor plate performance which affect bed material agglomeration. X-ray fluorescence analysis was performed on bed material sampled continually throughout the run to determine the changes in composition of major ash constituents.

6908 **Experimental research on lignite fluidized bed combustion.** Min-Shin, Y.; Li-Dan, Y.; Yi-Lin, B.; Yu-Kun, C. (Harbin Inst. of Technology, China). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 182-188(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Burning lignite fuel in fluidized beds has many obvious advantages: (1) high heat accumulation in the fuel bed. (This provides a sufficient heat source to dry and preheat the lignite and helps high moisture lignite to ignite in time, resulting in a stable combustion condition); (2) the normal temperature range for fluidized beds is 850 to 950°C (this is much lower than the lignite-deformation point); (3) ash erosion is not usually high; (4) since the operating temperature for a lignite fluidized bed boiler may relatively low, the load range can be much wider; (5) the erosion of the submerged tubes in lignite fluidized-bed boilers is not serious due to the relatively loose character of lignite ash; (6) the specific gravity of lignite ash is relatively low; (7) it's easier to ignite a fluidized-bed boiler; (8) when lignite fuel is thrown into the high-temperature fuel beds, the fuel is suddenly heated and crumbles easily by itself, allowing coal particles as-fired to be very coarse. At present, one of the main problems for existing fluidized-bed boilers is low combustion efficiency. The main reason for lower combustion efficiency and higher unburned combustible solids losses is the high carbon content in the fly-ash. The small particles may be blown off the high-temperature fluidized bed, resulting in an unburned carbon loss in the fly-ash. One of the important characteristics for firing lignite in fluidized-bed boilers is possibly that more volatile matter and small coal particles are burning in the suspension chamber (freeboard). The optimization of the combustion process in the suspension chamber to obtain better performance is an important factor in determining the combustion efficiency of lignite fluidized-bed boilers.

6909 **Pilot plant of a coal fired fluidized bed boiler in Japan.** Tamanuki, S. (Coal Mining Research Center, Tokyo, Japan); Karayama, H.; Kawada, S. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 189-195(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

A pilot plant of an atmosphere fluidized bed combustion boiler which is capable of evaporating 20 t/h at the steam conditions of 60 atg and 540°C was constructed and started operation at the beginning of April, 1981. A description of the project and its results are presented.

6910 **Research and development of coal-fired fluidized-bed boiler.** Dong-wen, B.; Yi-shao, R. (Dong-fang Boiler Works, Zigong, China). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 196-203(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The main reason for developing fluidized-bed boilers in China is to burn high-ash coal of low calorific value, and thus broaden the scope of energy resources. This appears to be especially important in the southern provinces. Practice over a number of years has indicated that FBB are promising, at least for industrial boilers and small electricity generating units in China. The application of FBB to utility power plants, however, depends on future development, economic factors, and the success of intermediate demonstration units. There is no doubt that many areas still need further investigation and that equipment could be improved, but we are convinced that a good start has already been made. Dong-fang Boiler Works now produces commercial FBB with steam capacity of up to 35 t/h. Units of greater capacity are under consideration.

6911 **Data acquisition and control system for a fluidized bed combustion unit.** Church, D.W.; Pincock, D.G. (Applied Microelectronics Inst., Halifax, Nova Scotia). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 204-208(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

A data acquisition and control system for a fluidized bed combustion unit has been described. It should be re-emphasized that the developed algorithm can be easily moved to read-only memory in a low cost controller. It is believed that the choice of major components has resulted in a system which is sufficiently general in nature to not only serve the current project but also to prove useful in future applications. The type of system described should find application wherever monitoring, recording and control of analog or digital signals and processes is required.

6912 **Sampling system for fluidized bed applications: results of four years of testing on B and W/EPRI's 6′ x 6′ fluidized bed test facility.** Loudin, K.L. (Babcock and Wilcox Co., Alliance, OH); Maurer, P.W.; Howe, W. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 209-217(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Gas sampling and analysis form a major portion of the performance evaluation of the 6′ x 6′ AFBC facility. The analysis requires measuring the concentration of its different gases at three sample locations - in-bed, freeboard, and furnace gas outlet. Sample flow rates of 6 to 10 liters per minute are needed for analyzing these gases. Accurate sampling and analysis from the high-temperature - high velocity, dust-laden environment of the fluidized bed unit requires the use of a system that includes certain special equipment. An efficient particulate filter is needed to clean the large-volume gas samples removed from the adverse environment of the 6′ x 6′ unit. A ceramic filter - constructed of inert material, self-cleaning, having minimum pressure drop, and able to withstand high temperatures and abrasive wear - served as the primary particulate filter in our final design. A cartridge-type secondary filter eliminated the glassware and decreased connection joints, while serving its main function of protecting the remaining sample system components in the case of a failure of the primary (ceramic) filter. Eliminating the quartz tube has produced a design that includes no fragile (glassware or quartz) components. The modifications have been combined to produce a refined gas sampling system that can be used at sample locations of interest in fluidized beds. It has been used for collecting and for accurately analyzing gas data over extended test periods for a multiple number of planned test conditions. These results have played a major role in the evaluation of the AFBC performance. The refined gas sampling system - developed for the 6′ x 6′ fluidized bed application - is recommended as a reliable system for fluidized bed units.

6913 **Influence of varying operational parameters on both the combustion efficiency in and the emission of pollutants from fluidized bed plants.** Muenzner, H.; Schilling, H.D.;. (Essen Bergbau-Forschung GmbH, Germany). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 218-225(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Our method of determining the influence of different operational conditions on fluidized bed plants consists in a stepwise alteration of one single operational parameter while maintaining the others as constant as possible. It is well known that this is easiest on a laboratory scale, whereas with increasing plant size the procedure becomes more and more onerous. If beyond operational parameters the design concept and the size of a plant are also varied, one obtains useful hints how to generalize and scale-up the results achieved. Present findings were obtained using several types of laboratory equipment with thermal performances between 2 and 20 kW as well as from a semi-technical plant of 300 kW. The C-loss is a critical factor for the economics of fluidized bed plants, whereas keeping the CO content in the flue gas within admissible limits generally does not pose any problems. As can be taken from figure 2, the two data sets are of a striking parallelity. The reason for this is that the more CO will be generated at reduced temperatures within the local and thermal transition zone between reactor zone and flue gas duct, the more carbon passes through this transitional zone as char carry over. Tars and volatile hydrocarbons were not observed. On being introduced into the hot ash of the fluidized bed, the coal will be dispersed immediately and exposed to the excess air whose oxygen reacts first with the volatile matter.

6914 **Sulfur capture and nitrogen oxide reduction on the 6′ x 6′ atmospheric fluidized bed combustion test facility.** Modrak, T.M. (Babcock and Wilcox Co., Alliance, OH); Tang, J.T.; Aulisio, C.J. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 226-242(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

An earlier state-of-the-art assessment (EPRI Final Report FP-308) concluded that the existing AFBC data base was inadequate for the design of utility-scale units - that is, the available data were limited in scope, and since they had been derived mainly from laboratory-scale equipment, it was doubtful whether they could be applied to the design of utility boilers. The need for a large, well-instrumented facility capable of long-term testing was clearly indicated. As a result, a 6-foot x 6-foot (6′ x 6′) AFBC Development Facility was built. A complete description of the facility design details are contained in EPRI Final Report CS-1688. Twenty-three test series have been completed covering over 7100 hours of operation. Data obtained thus far have clearly shown that fly ash recycle can improve combustion efficiency to the level needed for commercial operation. Recycle also improves sorbent utilization, thus reducing the limestone needed for sulfur capture. Measured NO/sub x/ emission levels are well below current EPA limits. However, two-stage combustion tests have shown that NO/sub x/ can be reduced to about 0.15 lb/million Btu. Additional work needs to be completed to improve sulfur capture and combustion efficiency with two-stage combustion. Information obtained thus far has allowed a significant improvement in our understanding of the AFBC process and should prove useful to researchers in this field. Further, design of prototype hardware and other equipment developed and tested on the 6′ x 6′ should prove useful for commercial design.

6915 Particle entrainment and nitric oxide reduction in the freeboard of a fluidized coal combustor. Walsh, P.M.; Chaung, T.Z.; Dutta, A.; Beer, J.M.; Sarofim, A.F. (Massachusetts Inst. of Technology, Cambridge). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 243-261(1982). (CONF-820304—Vol.2). Contract FG22-80PC30215.

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

Economic design of fluidized bed combustors requires a combination of fluidizing velocities and particle sizes which result in the unavoidable carry over of bed solids, coal char particles and unburned gaseous combustion products into the free-board. Depending upon the design parameters, the last 5 to 10% of the combustibles will burn, and also significant reduction of SO_2 and NO/ sub x/ will take place, in the freeboard of the fluidized combustor - between the top of the bed and the first row of the convective tube bank. A mechanistic model for particle entrainment into the freeboard has been developed and used in conjunction with a chemical kinetic description of the NO-char reaction for prediction of the reduction of NO along the height of the freeboard in fluidized coal combustion. Bed conditions, including the mass fraction of char in the bed, are input to the model. Predicted NO profiles showed good agreement with experimental data obtained while burning bituminous and subbituminous coals under a variety of operating conditions. The steep reduction in NO observed in the splash zone immediately above the bed in some cases could not be adequately explained by the present model. This result points to the importance of the reactions in the splash zone, where it is thought that NO reducing reactions other than the NO-char reaction will have to be taken into account for satisfactory prediction of the NO profile under all conditions. The model is now in a form in which it can be integrated into system models for predicting NO emissions as a function of operating conditions.

6916 Reduction of nitric oxide by carbonaceous solids in an atmospheric pressure fluidized-bed reactor. Huang, Z. (West Virginia Univ., Morgantown, WV); Chen, G.T.; Wen, C.Y.; Shang, J.Y.; Mei, J.S.; Notestein, J.E. *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 274-287(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The fluidized-bed combustion process, due to its ability to control pollutant emissions and its inherent capability to accommodate a wide variety of fuels, has been the subject of accelerating development for industrial and utility applications. However, fluidized-bed combustion boilers based on the current design and operation may not be able to meet the future stringent standards on nitrogen oxides emissions without additional provisions. In this paper, a preliminary study on the reduction reactions of nitric oxide with three different carbonaceous solids using a 9.6-centimeter diameter, electrically heated, batch fluidized-bed reactor operated at various design and operating conditions is discussed. Results of this investigation indicate that the NO reduction reaction appears to be dependent upon not only the operating variables such as bed temperature, carbonaceous solid loading in the bed, but also on the physical properties of the carbonaceous solids as well. Prediction of NO reduction by one of the carbonaceous solids using a two-phase bubble model shows good agreement with experimental data within the range of experimental conditions.

6917 Effect of coal particle size on the performance of a fluidised bed coal combustor. Brikci-Nigassa, M.; Garbett, E.S.; Hedley, A.B. (Univ. of Sheffield, England). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 288-294(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

This paper reports a study of the combustion of monosized coal fractions fed continuously to the bed via an overbed feeder. Data showing the effect of coal size, excess air and combustion efficiency are presented. Measurements using crushed coal (<1.5 mm) fed pneumatically to the bed are included for comparison. The measurements of nitric oxide concentrations in the bed and freeboard of the 0.3 m square fluidised bed have shown that nitric oxide is produced within the bed and are reduced in the freeboard. Elutriation rates and NO concentrations measured at the exit of the freeboard both decrease with increasing coal particle size up to a size of a 9.5 mm for most conditions. The combustion of monosized coal particles in the fluidised bed has highlighted the interdependence of elutriation rate, bed carbon content, carbon concentration in the freeboard and nitric oxide emissions. The results also indicate that an optimum operating condition for this particular fluidised bed combustor may exist for the 9.5 mm coal size at 20% excess air. However, further experimental results are necessary, in particular with respect to the complex phenomena occurring in the freeboard region.

6918 Influence of particle size distribution on the combustion rates in a batch fed fluidized bed. Garbett, E.S.; Hedley, A.B. (Univ. of Sheffield, England). *Preprints of Papers - American Chemical Society, Division of Fuel Chemistry;* **27**: No. 1, 295-306(1982). (CONF-820304—Vol.2).

From 183. American Chemical Society annual meeting; Las Vegas, NV, USA (27 Mar 1982).

The design of such FBC's is based on the practical experience gained from pilot plant studies and also on the predictions of mathematical models. Central to any model of coal combustion in FBC's is the rate at which particles burn in the bed which determines the carbon loading and hence pollutant emissions, heat release rates, coal feed rates and elutriation rates. Particle size and temperature usually indicate the controlling mechanism of combustion; large particles and high temperature suggest that diffusion is dominant whereas chemical kinetics became important for small particles and low temperatures. In a typical FBC the particle sizes range from that of the maximum of the input feed down to that of particles which are about to be elutriated and particle temperatures can have a value anywhere between the bed temperature T/sub b/ and T/sub b/ + 200K. The particle size distribution of the coal feed is a parameter which is important in the design of FBC's but whose influence on the combustion rates in the bed has not been studied. It is the purpose of this paper therefore, to develop a theory to predict the burnaway, burnout time and particulate phase oxygen concentration in a batch fed FBC and show their dependence on the input particle size distribution which is accurately known.

6919 Development of coal-water slurries as a boiler fuel. Henderson C.B.; Scheffee, R.S. (Atlantic Research Corp., Alexandria, VA). pp 218-225 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The development of slurries of coal and water as a boiler fuel replacing No. 6 fuel oil has been actively pursued at the Atlantic Research Corporation since 1976. The name ARC-COAL has been selected for these slurries. Stable coal-water slurries with bone-dry coal loadings between 62% and 73% have been prepared, evaluated rheologically, and successfully burned in a one-million Btu/hr experimental furnace without the assistance of other fuels. The advantages, market, and economic factors of coal-water slurries are discussed. The properties of these slurries, the experimental techniques employed in burning, and the combustion results are reviewed. The advantages of coal-water slurries as a boiler fuel are: The attendant advantages in handling, transportation, and storage of a liquid fuel; low cost; low capital investment; capability of early utilization; independence of foreign raw materials including oil; capability for integration with coal-cleaning; and capability of integration with coal-water slurry pipelines. The displacement of coal by oil in the energy market place between 1940 to 1973 arose, to a large extent, from the simplicity and the resultant economic savings of handling a liquid fuel as opposed to solid coal. Calculations show that, for a coal-water slurry with 30% water, 3.1% of the energy of the coal is required to vaporize the water and heat it to the temperature of the flue gas leaving the air preheater.

6920 **Coal/oil mixture experience at Florida Power & Light Company.** Gilbert, B.F.; Jackson, G.E. (Florida Power & Light Co., Miami). pp 226-235 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The modified fuel supply system is designed to allow switching from COM to straight No. 6 oil without shutting down the boiler, thus giving this generating unit the dependability and reliability required for uninterrupted operation. For use with the COM fuel the high pressure, mechanically atomized burner guns originally used for oil firing were replaced by low pressure externally steam atomized ones. Ths is the heart of the combustion process. The proper atomization of the fuel and its mixing with air is essential for good combustion, maximum heat transfer and boiler efficiency. Technologically, the state of the art for oil atomization and coal pulverization is well developed, but combining the two fuels into one creates a demand for new technology. Our research and investigations showed that very little knowledge and practical experience existed in the area of atomization and combustion of large quantities of COM over long periods of time. When the amount of coal was varied from 10% to 50%, it actually changed the fuel characteristics and its behavior in the furnace, since the release of heat from coal is slower than oil. Coal combustion requires seven times as much excess air as oil for complete combustion. The typical ash constituent of oil is .1% while coal ash is 8 to 10%. Thus, when the two fuels ignite and burn their inorganic chemistries combine to form compounds that are individually different. One of our objectives was the continuous operation of the unit to determine if we would be encountering a significant problem with ash buildup inside the furnace. Unlike oil, the removal of coal ash from the boiler must be a continuous process.

6921 **Direct combustion of peat for electric power generation.** Leppa, K. (Ekono, Inc., Bellevue, WA). pp 27-44 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The current status of power generation from peat is reviewed with respect to its proportions and role in the nation. Countries presented are Ireland, representing a significant proportion; the Soviet Union, representing a large, absolute volume; and Finland, representing a recent rapid development. The important characteristics of peat that effects handling and combustion are presented as a background for design parameters of the equipment. Considerable attention is paid to combustion equipment and its design parameters to prove the prompt availability of a variety of established techniques. Burners and combustors, the essential items of the combustion process are discussed in some detail. Aspects of co-firing with other fuels and retrofitting to peat are presented as means of a rapid introduction of the new fuel. Peat handling poses more problems than any other part of the peat-based power plant operation. Facilities for receiving, conveying, and storing peat are discussed, with special attention to the aspects of dimensioning and designing for safety. As a tool of decision making, the costs of peat-fired generating plants are discussed, based mainly on recent Finnish cases, using technical and economic comparisons with oil and coal firing. The display of the effects of plant size and load factor give an indication of the limits of feasibility.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 6715, 6719, 6726, 6811, 6862, 7737

6922 **(NP—3900412) Costs and benefits of federal regulation of coal strip mining. Report E-82-08.** Kalt, J.P. (Harvard Univ., Cambridge, MA (USA). Energy and Environmental Policy Center). Aug 1982. 46p. Harvard University, Kennedy School of Government, Energy and Environmental Policy Center, Cambridge, MA 02138.

This study has attempted to assess the aggregate costs and benefits of Surface Mining Control and Reclamation ACt of 1977 (SMCRA). This has required a model of the US coal market, as well as disaggregated estimates of the costs of satisfying SMCRA's standards and the values of the environmental amenities yielded by coal-bearing land areas. Both the costs and benefits of strip mining regulation increase as policy moves from the West through the Midwest to Appalachia. SMCRA is least cost-effective in Appalachia, where stringent regulatory requirements produce a high level of environmental benefits at an even higher level of costs. SMCRA performs better relative to economic criteria of efficient resource use in the Midwest and West, although it apparently fails the overall national cost-benefit test and imposes aggregate dead-weight losses on the nation's economy in the range of $100 million per year. It does this while transferring significant amounts of income from coal consumers ($400 million per year) and surface coal producers ($980 million per year) to underground coal producers ($130 million per year) and the consumers of environmental amentities ($1.1 billion per year).

6923 **(PB—82-208612) Fuel price and supply projections, 1980-2000. Final report.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jun 1980. 257p. NTIS, PC A12/MF A01.

In 1978, over 95 percent of California's energy was derived from conventional fuels--oil, natural gas, coal, and uranium. This report documents projections on future supply, price, and availability of these fuels and presents information on historical fuel use and price for background and perspective. Analyses of commercially developable derived fuels and of recent federal statutory restrictions on the use of oil and gas are also presented. These analyses include economic, logistic, environmental, geologic, and social and institutional considerations.

6924 **Coal's role in meeting world energy needs.** Coleman, L.R. (Skadden, Arps, Slate, Meagher & Flom, Washington, DC). pp 236-239 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The market for US coal is described as fuel for fossil-fuel power plants (limited in growth by little retrofitting of oil and natural gas plants so far and more recently by deteriorating financial condition of utilities), synthetic fuels (not immediate) and exports. The possibility of increased exports is regarded as good (but depends on prices, prompt and reliable delivery, dependable quality and also the strategy of purchasers, other country exporters and government policies. Problems with respect to port congestion and road and railway conditions are discussed. The need for dredging in certain ports to accommodate larger ships is considered. Finally, the lack of federal eminent domain legislation for slurry pipelines is discussed. (LTN)

0160 Health And Safety

REFER ALSO TO CITATION(S) 6726, 6850, 6851, 6974, 8286, 8460

6925 **(PB—82-209719) Mine grounding systems: development of tests and criteria to evaluate grounding systems. Open file report 1 Jul 78-15 Sep 79.** Cooley, W.L.; McConnell, R.L. (West Virginia Univ., Morgantown (USA). Engineering Experiment Station). Sep 1979. 150p. NTIS, PC A07/MF A01.

This report covers tests and criteria for the establishment of safe grounding systems for coal mines. The work deals primarily with underground mines, but much is applicable to surface mines as well. Included is an extensive guide to grounding and bonding procedures for mine surface substations. Xit-Rods (Chemically charged, hollow-rod electrodes that generate their own moisture and metallic salts and uses the resulting electrolyte as the interface medium between the conducting surface of the rods and outwardly in the soil and lowers resistance) are evaluated and shown to deviate from manufacturers claims. An analysis shows that very long cables are difficult to monitor using audiofrequency ground-check techniques. A method is developed to detect failing cable splices without removing the cable from service. Simulation and measure-

ment are compared for a technique to detect bad rail bonds, and an assessment is made of grounding techniques for dc face equipment.

6926 **(PNL-SA—10824) Summary of health and environmental research relative to direct coal liquefaction.** Gray, R.H.; Mahlum, D.D.; Strand, J.A.; Weimer, W.C. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1982. Contract AC06-76RL01830. 26p. (CONF-821048—2). NTIS, PC A03/MF A01. Order Number DE83002707.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

This paper summarizes the health and environmental research (1976 to the present), supported by the US Department of Energy (DOE), to assist the development of environmentally acceptable coal liquefaction processes. Four major direct coal liquefaction processes have been investigated at the pilot plant stage of development. These include two solvent refined coal processes (SRC-I and -II), H-coal (a catalytic liquefaction process) and Exxon donor solvent (EDS). The DOE health and environmental research program includes short-term screening of coal-derived materials for possible health and environmental effects. Longer-term assays are used to evaluate materials considered most representative of potential commercial practice and with greatest possibility for human exposure or release to the environment. Integrated chemical analyses are being used to identify the compounds and compound classes in coal-derived materials that are responsible for biological activity. Effects of process modification, control technologies and changing operational conditions on potential health and environmental effects are also being evaluated. Significant results of DOE's research efforts relative to direct coal liquefaction are contained herein.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 6719, 6891

02 PETROLEUM

0203 Drilling And Production

REFER ALSO TO CITATION(S) 6949, 8030

6927 **(BMFT-FB-T—81-225) Secondary recovery: Change of the viscosity and compressibility of mineral oils by dissolved gas.** Kuss, E.; Killesreiter, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 64p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750411.

Secondary and tertiary oil recovery methods for an enhancement of the production rate are mostly based on a reduction of the mobility ratio water/oil. This can be achieved e.g. by lowering of the oil viscosity by heat or dissolved gases. To investigate this problem, the viscosity of selected oils like paraffinic oil, naphthene based distillate, and solvent extract has been measured with a new developed capillary viscometer in dependence on p, T and the mole fraction of dissolved gases N_2, CO_2, CH_4 and C_6H_6. The results show the decreasing viscosity with increasing gas concentration that amounts to nearly three orders of magnitude using propane. Apart from absolute values of the viscosity, the general form of the curve for saturated isotherms in dependence on the pressure is determined only by the gas and not by the oil. This facilitates estimations as it has been shown earlier with the model substances squalane and squalene. For a further interpretation solubility isotherms have been measured and a high pressure piezometer for gas/oil solutions designed and proved.

6928 **(BMFT-FB-T—82-111) Improvement of the casing cementation of deep and ultra-deep wells. Pt. 1.** Arens, K.H.; Akstinat, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1982. 137p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750972.

The subjects of the final report of the research project ET 3012 A (Improvement of the casing cementation of deep and ultra-deep wells) are drilling muds, washers/washing fluids and oilfield cements. The research work on drilling muds covers the rheological requirements, the temperature stability of mud systems and the properties of non-damaging drilling muds. Besides the development of two novel test methods the research work on washing fluids shows the necessity of filter cake removal. The efficiency of several washing fluids is compared and evaluated for various mud systems (drilling muds with and without clays)..

6929 **(BMFT-FB-T—82-112) Improvement of the casing cementation of deep and ultra-deep wells. Pt. 2.** Arens, K.H.; Akstinat, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1982. 115p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750970.

The final report of the research project ET 3012 A (Improvement of the casing cementation of deep and ultra-deep wells) are drilling muds, washers/washing fluids and oilfield cements. The research work on oilfield cements includes the characterization and evaluation of the main oilfield cements commercially available. The testing was carried out according to API-Standards and non-standardized test methods (dyn. E-modulus, expansion/shrinkage), especially the rheology, thickening time and the influence of pressure, temperature and water-cement-ratio are considered. The main emphasis of the research work in the field of cement additives was the evaluation of cement retarders for high temperatures, accelerators and additives for cement expansion. Furthermore new oilfield cements are tested, and their properties are described..

6930 **(DOE/ET/13406—1) Electrochemical analysis of surfactants for enhanced oil recovery. Final report.** Glover, C.J. (Texas A and M Univ., College Station (USA). Dept. of Chemical Engineering). Sep 1982. Contract FG19-78ET13406. 34p. NTIS, PC A03/MF A01. Order Number DE83003032.

Surfactants are being considered by the oil industry as one means of achieving enhanced oil recovery (EOR) from oil reservoirs. The process involves injection of a surfactant solution that is designed to provide interfacial tension low enough to mobilize the discontinuous oil phase in a reservoir after secondary waterflood operations. Maximum success with such a process requires, among other things, that the surfactant be propagated through the entire reservoir from the injection well to the production well with a minimum of surfactant loss to the rock surface due to adsorption. The objectives of this project have been first, to determine if an electrochemical means of surfactant quantitative analysis could be developed which would give accurate results over a wide range of concentration in applications relating to tertiary oil recovery and second, to initiate surfactant adsorption studies, using this electrochemical technique as appropriate. The development of an electrochemical technique has been only partially successful. An indirect technique previously reported in the literature was modified for application to microemulsion systems that may include, in addition to surfactant, oil, alcohol, and brine components. Reasonable calibration curves were obtained for sodium dodecylbenzene sulfonate and a monoethanolamine (MEA) alkylorthoxylene sulfonate that has been used for enhanced oil recovery studies. Further development of the method for continuous adsorption studies, however, has been limited by problems with obtaining consistent results from the nitration reaction required for the technique.

6931 **(DOE/SF/01424—T1) Multi-pattern low-tension demonstration flood, Big Muddy Field. Technical progress report no. 40, July through August, 1982.** Painter, T.R. (Conoco, Inc., Casper, WY (USA)). 1982. Contract AC03-78SF01424. 18p. NTIS, PC A02/MF A01. Order Number DE83002457.

Portions of document are illegible.

Injection of the chemical slug was completed on August 9, 1982. An estimated total of 888,100 barrels of the slug were injected. Polymer-pusher slug injection began the same day at about the same rate and viscosity as the surfactant phase. Injectivity continues to be a primary concern. The pressure falloff tests run in three project injectors disproved the plugging theory and pointed toward a thief zone as the cause of the decline. An interference test is planned to study this theory. Oil production from the DOE project continues to increase. Oil rates for the three months in the third

quarter averaged 118, 134, and 146 barrels per day, respectively. Sulfonate has appeared in seven of the sixteen producers, but no treating problems have been experienced to date. A series of sulfonated oil treating tests were performed in July with promising results. It was found that with chemical and heat addition, and residence time, the sulfonated crude can be successfully treated to pipeline water specs and undetectable free sulfonate levels. Based on the results of this test, a full scale treating facility will be designed and installed.

6932 (NP—3900338) **Offshore logistics.** Bischoff, R. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Wirtschaftswissenschaften). 8 Nov 1979. 192p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE83900338.

Thesis.

The planning of drilling platform cranes is presented by means of the investment costs and the breakdown costs in case of supply failures of various platform types. The critical range of costs of different crane types is determined. The planning of the supply ships to be chartered is based on their utilization as time-table independent vehicles. The requirements made to the capacity and the performance of services of ships are developed separately. The consideration of costs caused directly by various types of supply ships and, indirectly, by breakdown costs in platforms leads to comprehensive tables of decision. The planning of the number of anchorage basins in a supply base takes into consideration the utilization of supply ships with the aim of avoiding delays in the supply of platforms. The theoretical derivation of a planning approach is verified by the help of an empirical investigation.

6933 **Laboratory evaluation of PDC drill bits under high-speed and high-wear conditions.** Hoover, E.R.; Middleton, J.N. (Sandia Natl Lab, Albuquerque, NM, USA). *Journal of Petroleum Technology;* **33**: No. 12, 2316-2321(Dec 1981).

Recently, five experimental polycrystalline diamond compact (PDC) bit designs were tested in the laboratory at 100 and 500 rpm in three different types of rock: Nugget sandstone, Crab Orchard sandstone, and Sierra White granite. This study describes the testing procedures, summarizes bit performance and wear characteristics, and correlates these experimental results with specific design options such as rake angle, bit profile, and material selection. 4 refs.

0204 Processing

REFER ALSO TO CITATION(S) 6751, 6756, 6942

6934 (CONF-8105173—, pp 5p, Paper 4) **Fuel cleaning: cleaning of oil and gas.** Labuda, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Papers on the desulfurization of oils and natural gas are reviewed and questions raised are listed. (LTN)

6935 (CONF-8105173—, pp 5p, Paper 5) **Desulphurization of residual fuels by conversion.** Hamann, R. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In most European countries the desulphurization of distillates results in a sizable reduction of sulphur dioxide pollution levels in cities. The present trend, motivated by Governments, to convert petroleum residues to lighter products improves not only future coverage of market demand but makes also a very important contribution to further reducing sulphur dioxide emissions from petroleum fuels. The conversion processes widely applied in the petroleum industry combine partial desulphurization with an additional yield of white products under economic conditions. The rising number of conversion facilities going into operation will take up as feedstock the total amount of atmospheric residue available. It can be demonstrated that, with regard to air conservation, conversion of residual oils into light components is as effective as the desulphurization of residues solely. Increased conversion results in lighter products which can be reduced in sulphur content. The sulphur is produced as elemental sulphur in the well-established Claus process. It is pointed out that the increasing rate of conversion is causing rising production of sulphur in the refineries up to the year 2000. Therefore, the petroleum industry has already taken care of the problem of sulphur emission to the environment in such a way that no additional refinery installations are necessary for the sole purpose of desulphurizing residual fuel oils.

6936 (CONF-8105173—, pp 8p, Paper 19) **Low-temperature oxidative gasification of high-sulphur oil residues.** Maslennikov, V.M.; Kreymer, S.M.; Ryjak, E.L. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Although the role of residual petroleum products in the fuel balance of power stations has declined substantially because of the liquid fuel deficit, the problems of environmental protection for existing power stations using high-sulfur liquid fuels have in fact become much more acute, because these power stations are usually located in industrial regions and near population centres. The absence of a large open space in the vicinity of the power station makes it impossible to erect cumbersome gas purification facilities, while the introduction of vapor gas power installations with intracycle fuel gasification requires radical reconstruction of the plant. This paper describes the technology for, and provides a technical and economic analysis of, a system for low-temperature oxidative gasification of oil residues producing gas of increased thermal capacity (compared with conventional methods of fuel gasification) and residual liquid products. When the parameters of the process are combined in a particular way, carbon enrichment of the residual liquid products is unnecessary, so that they can be recycled for further gasification, thus forming a closed-cycle technological process. After removal of the ash and sulphurous compounds, the power gas can be burned in furnaces at existing boiler units. Because of the high intensity of the gasification process and the use of increased pressures, compact and highly productive equipment that does not require much space for installation at the power station and rigid attachment to existing boilers can be designed.

6937 (CONF-8105173—, pp 4p, Paper 25) **Sulphur in petroleum refining.** Bouveng, H.O. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The material presented briefly in this paper provides but another illustration of the well-known fact that a major part of the crude-oil sulfur is tied to those fractions which are most difficult and costly to desulphurize. It implies, furthermore, that reduction of sulfur dioxide emissions by an enforced switching to low sulfur crude oils would be a method of limited applicability. For decisions concerning large-scale transfrontier pollution, there seem to be no more than two alternatives available. One is to sit back claiming that the cost of doing anything would be too high. The second alternative is a non-prejudiced study based on a medium- to long-term perspective, examining conventional as well as non-conventional systems for extracting energy from heavy petroleum fractions with less emission of sulfur dioxide than currently.

6938 (CONF-8105173—, pp 10p, Paper 45) **Effect of changing patterns of petroleum product demand on the emissions of sulphur in western Europe.** Ellis, J.F.G.; Hopper, W.C. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The selection of rational control measures for SO_2 emissions should be based on an evaluation of trends in the levels of discharge and changes in the predominant sources of discharge over the economic life of the control equipment. Projections based on identifiable trends in the primary sources of energy to the year 2000 indicate that crude oil will provide a decreasing proportion of total energy over that period. Further, the pattern of petroleum products will change with an emphasis on the production of light, refined products resulting in a marked decrease in the quantity of residue for use as fuel oil. This trend has two important consequences related to sulfur emissions from the petroleum sector: (a) larger quantities of sulfur will be recovered during the refining process and,

thus, not emitted to the atmosphere; (b) smaller quantities of residues will be available for blending fuel oils and their characteristics may render them unsuitable for desulphurization. Estimates for the energy consumed in desulphurizing these residues range from 16 to 19 percent of the fuel oil produced. The costs for desulphurization vary, depending on the characteristics of the residue feed stock. Costs for specific feedstocks quoted range from $40 to $147 per tonne of 1 percent sulfur product in 1980 economic values.

6939 (CONF-8105173—, pp 7p, Paper 56) **Overview of cost estimates for residual desulphurization.** Landheer, F.; Labuda, J. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Most of the sulfur in the 650 million barrels of crude oil processed annually in Canada tends to concentrate in the residual product and when combusted results in an estimated annual sulfur dioxide emission of 420,000 tonnes. This air pollution problem could be reduced if the residual oil sulfur content of 3 to 3.4 percent by weight was reduced to either 1 or 0.5 percent by weight. Five processes were selected for desulphurizing the common residual oils produced in Canada. A consulting firm developed capital - operating cost estimates for hydrodesulphurization facilities of 20,000 barrels per day capacity. The process licenser supplied design data and material balances while the consultant developed the estimates of costs. The following conclusions may be drawn: (a) the Hydrocarbon Research Inc. H - Oil process has the lowest investment and cost; (b) the cost for H - Oil desulphurization of residual oil ranges from $15 to $29 per tonne. This is equivalent to about $2.5 to $4 per tonne of crude oil; (c) the costs for other desulphurization processes range from $21 to $34 per tonne of residual oil; (d) the Gulf Resid HDS process requires the least hydrogen for desulphurization; and (e) the energy consumption for desulphurization ranges from 4.1 to 8.2 percent of the feed. With a desulphurization cost of $2.5 to $4 per tonne, it would appear that crudes with high sulfur content will become competitive as refinery feed with the higher priced low sulfur crudes. Countries considering desulphurizing flue gases should also consider the fuel desulphurization strategy.

6940 (DOE/PC/30229—4) **Thermal reactions of aromatics with CaO. Technical progress report, May 1, 1982-August 31, 1982.** Longwell, J.P.; Lai, C.K.; Williams, G.C.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1982. Contract FG22-80PC30229. 19p. NTIS, PC A02/MF A01. Order Number DE83001481.

The activity of CaO for the cracking of benzene is known to be very dependent on the calcining temperature and the optimal temperature is 550°C. An optimal calcining time of 2 hours at 550°C was determined. The considerable scatter in the activity data suggests that the benzene pyrolysis temperature, which is higher than the calcining temperature, may have modified the physical and chemical properties of the CaO during the post-calcination period. Basicity measurements on CaO samples calcined for different time periods show no correlation between basicity and activity for benzene cracking. Infrared analysis of a calcined mixture of CaO and quartz showed no evidence of the presence of any silicate complexes. 7 figures.

0206 Health And Safety

REFER ALSO TO CITATION(S) 6974

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 6923, 6944, 6948, 7737

6941 (NP—2750311) **Petroleum report 1980.** (Oliebranchens Faellesrepraesentation, Copenhagen (Denmark)). 1981. 24p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750311.

A brief description is given of the international petroleum situation, and a survey is made of the Danish petroleum supply and of the petroleum industry in relation to e.g. new Danish governmental reglations, Energy Plan 81, and the energy debate. Statistics are given of Denmarks petroleum consumption for the years 1972 to 1980, forecasting of Danish energy consumption to the year 2000, the World's petroleum production, and the trend of the petroleum prices.

0208 Waste Management

REFER ALSO TO CITATION(S) 6939, 7277, 8347

6942 (CONF-8105173—, pp 12p, Paper 40) **SO_2 stackpol process for desulphurizing flue gas and its use for pollution control in refineries.** Barthel, Y.; Deschamps, A.; Franckowiak, S. 1981. (In French). NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The French Petroleum Institute has developed a desulphurization technique for flue gas which consists in scrubbing it with ammonia, followed by treatment of the resultant brine to yield SO_2 and recycling of the ammonia to the washing section. The SO_2 thus produced can then be transformed either into sulfur (in a Claus unit) or into sulphuric acid. The paper describes the various stages of the process. It then studies its applicability to a 6 million tpa refinery, where it has reduced SO_2 emission from 50 tonnes a day to 25 tonnes a day. The SO_2 produced by the process is converted into sulfur in the plant's existing Claus unit, the throughput of which has been increased by 24 percent. Capital and operating costs are given so that the economics of the process may be calculated.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 8346, 8347

6943 (EGG—1183-2452) **Biological assessment: possible impacts of exploratory drilling in sections 8B and 18H, Naval Petroleum Reserve No. 2, Kern County, California on the endangered San Joaquin kit fox, blunt-nosed leopard lizard, and other sensitive species.** O'Farrell, T.P.; Sauls, M.L. (EG and G, Inc., Goleta, CA (USA). Energy Measurements Group). Jul 1982. Contract AC08-76NV01183. 48p. NTIS, PC A03/MF A01. Order Number DE83003044.

The U.S. Department of Energy proposes to drill exploratory wells on two sections, 8B and 18H, within Naval Petroleum Reserve No. 2 in western Kern County, California. The proposed sites are thought to provide habitat for the endangered San Joaquin kit fox and blunt-nosed leopard lizard, as well as two sensitive species: the giant kangaroo rat and San Joaquin antelope ground squirrel. The objective was to assess the possible impacts of the exploratory drilling on these species and their essential habitats. Although 23 potential San Joaquin kit fox den sites were found during surveys of a total of 512 ha (1280 acres) surrounding both well sites, no burrows were closer than 30 m from proposed disturbance, and most were over 200 m away. Two blunt-nosed leopard lizards were observed on private land within 8B, one was observed on private land in 18H, and two were seen on DOE portions of 18H. No evidence of blunt-nosed leopard lizards was gathered in the immediate vicinity of either proposed well site. Although 5 ha of habitat will be disturbed, there is no evidence to indicate any of the species has burrows on-site that will be lost during land clearing. Loss of habitat will be mitigated during the cleanup and restoration phases when disturbed areas will be revegetated. Increased traffic, human activities, noise and ground vibration levels, as well as illumination throughout the night, may disturb the fauna. However, these species have adapted to intensive human disturbances on Elk Hills without obvious negative effects. The short duration of the project should allow any displaced animals to return to the sites after drilling ceases.

6944 **(OCS—78-Draft) Proposed 1983 outer continental shelf oil and gas lease sale offshore the South-Atlantic states. Draft environmental impact statement.** (Minerals Management Service, New York (USA). Atlantic OCS Region). Oct 1982. 430p. Dept. of the Interior, 26 Federal Plaza, Suite 32-120, New York, NY 10278.

Portions of document are illegible.

The proposed action is the offering of 5733 blocks (33 million acres; 13.2 million hectares) located from 12 to 215 statute miles offshore North Carolina, South Carolina, Georgia, and Florida for leasing in accordance with the Outer Continental Shelf Lands Act, as amended. The tracts lie in average water depths of 20 to 4500 meters (66 to 14,765 feet). Under the final five-year leasing schedule, which was approved in July, 1982, Sale No. 78 would be held in July, 1983. Alternatives considered include a delay of the sale, cancelling the sale (no action), and two deletion options. The deletion options include: one to protect coastal and nearshore resources and one relating to blocks in the NASA Kennedy Space Center Flight Clearance Zone. All tracts studied pose some degree of risk to the environment. Mitigating measures, which may reduce the risk, have been identified.

6945 **(PB—82-220849) Tests of the Shell sock skimmer aboard USNS Powhatan. Final report.** Lichte, H.W.; Borst, M.; Smith, G.F. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Sep 1981. 92p. NTIS, PC A05/MF A01.

The Spilled Oil Containment Kit (SOCK), developed by Shell Development Company, was tested in a controlled crude oil dumping off the New Jersey Coast in early 1980. The skimmer had been designed as a physical attachment to an oil industry work boat in a vessel-of-opportunity deployment mode. The United States Naval Ship (USNS) Powhatan T-ATF fleet tug was chosen as a similar vessel and one that had an oil spill recovery operation mode. The test program is described, including the oil/water distribution and collection system, deployment and retrieval of the SOCK, the onboard fluid measurement, data analysis, logistics, weather and environment measurements, and the Powhatan/SOCK interface. The light crude oil and ocean water collected were stored aboard the vessel and decanted; the emulsified oil was later sold as waste oil. Eight experimental crude oil dumps are described and analyzed. The sea conditions varied from calm to 1.8-m significant wave heights. During the 6 days at sea, 50cu m of oil were dumped, and the skimmer collected 32 m of oil. The program is analyzed for future improvements to open ocean testing plans incorporating oil skimmers with and without vessels of opportunity.

6946 **Measures to combat oil pollution: the improvement of oil spill response within the European Economic Community.** London, England; Graham & Trotman Ltd. (1980). 274p. (EUR—6802-EN). Graham & Trotman Ltd., Bond Street House, 14 Clifford Street, London W1X 1RD, England.

The arrangements for marine oil spill response are described for Belgium, Canada, Denmark, Federal Republic of Germany, Finland, France, Greece, Ireland, Israel, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom and United States of America. The basic approaches adopted within these countries are discussed in relation to resources threatened by oil pollution, assessment of pollution risk, clean-up policy, designation of clean-up responsibility, organisation for clean-up response, manpower and equipment resources, and research and development. Training schemes and international agreements for co-operation in oil spill combat in European waters are also considered. A critical appraisal of the response to past major oil spills is given and a number of conclusions and specific topics requiring action are identified. Recommendations are made to enhance the effectiveness of the existing national arrangements for oil spill combat through further international co-operation. These include the establishment of an inventory of clean-up equipment and materials; a databank on the properties, behaviour and amenability to clean-up techniques of oils; the promotion of co-operation and information exchange regarding research, development and testing of clean-up equipment and materials; the encouragement of training schemes; and the sharing of certain specialised clean-up techniques.

0210 Legislation And Regulation

6947 **(NP—2750312) Agreement of 19 May 1981 between the Minister of Energy and the Licensees under the terms of exclusive licence of 8 July 1962 with appendix referring to its legal basis.** (Energiministeriet, Copenhagen (Denmark)). 1981. 101p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750312.

The Danish Minister of Energy signed an official agreement with the hitherto sole licensee of the Danish underground mineral rights, DUC (Danish Underground Consortium). The areas of exploration are reestimated, exploration and mineral rights will be transferred to the state-owned company DONG in three terms - 50% in 1982, 25% in 1984 and the rest in 1986. Detailed regulations indicate the duties of DUC to explore hydrocarbon deposits, sell the agreed part of recovered products to the state and to provide continuous supplies. Appendices and former laws give the legal frames of the whole hydrocarbon supply procedure, from exploration to pipeline distribution system and refining processes.

0220 Transport, Pipelines, And Handling

6948 **(DOE/EIA/10754—T16) Complementary data systems: FRS involvement in oil pipeline companies. Final report.** (Synergy, Inc., Washington, DC (USA)). 16 Feb 1982. Contract AC01-81EI10754. 55p. NTIS, PC A04/MF A01. Order Number DE83003113.

Portions of document are illegible.

The Financial Reporting System (FRS) has identified 26 major integrated oil companies that form the basis of their analyses. In an effort to minimize the burden of requiring additional respondents to participate in the FRS system, the FRS seeks to support current and future efforts by utilizing complementary data systems, both within the DOE, from other government agencies, and from private sources. This project evaluates the potential for supplementing the FRS data collection system with data collected by the Federal Energy Regulatory Commission (FERC) for interstate crude oil and products pipeline companies. The approach here is to evaluate the potential for merging the FRS with the FERC Form P data in order to obtain additional information about interstate oil pipeline companies. A line-item by line-item comparison of the FRS's EIA-28 form and the FERC Form P was made, both conceptually and by comparing actual data, to determine if one form could be built from the other and how much additional information could be provided by combining the two forms. Actual data were reviewed in order to evaluate that potential. Although the issue of the potential for complementary data systems is the central focus of this project, that issue must be considered within a broader context, one that makes the data comparison meaningful in an analytical sense. A number of questions were posed at the beginning of the study for careful review upon its completion.

0230 Properties

REFER ALSO TO CITATION(S) 6927, 8031

6949 **(DOE/MC/11284—17) Phase behavior studies of Appalachian crudes with carbon dioxide. Final report, September 28, 1979-September 30, 1981.** Monger, T.G. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Nov 1982. Contract AM21-79MC11284. 83p. NTIS, PC A05/MF A01. Order Number DE83002979.

The phase behavior of thirty mixtures of Appalachian crude oil and carbon dioxide are described. Stock tank oils from the Hilly Upland field in northcentral West Virginia, and the Bath field in northcentral Ohio are examined in the presence of equimolar amounts of CO_2. The effects of small amounts of contaminant gases are probed using methane, nitrogen, hydrogen sulfide and sulfur dioxide. Additional changes due to the presence of brine are studied. Data was collected in single-contact phase equilibrium experiments using a high pressure windowed condensate PVT cell. The volumetric behavior of sample mixtures was monitored. Total sample and individual phase volumes were recorded up to pressures of 3600 psi, and at temperatures above and below the CO_2 critical

temperature. Saturation pressures and the extent of oil swelling were determined from the PVT measurements. Significant results show that the phase equilibria determined for CO_2-Appalachian crude oil mixtures generally emulate that reported for Western crude oil systems. Although swelling indices were generally insensitive to small additions of CH_4, N_2 or H_2S; swelling is promoted by SO_2 in the absence of brine. Bubblepoint pressures were notably affected by the additives studied. Changes in bubblepoint pressure induced by small additions of additive gas correlate inversely with the gas critical temperature. While some precipitate formation is reported for CO_2-Western crude oil mixture, no solid phase was observed for equimolar CO_2-Appalachian crude oil mixtures. Brine can stimulate precipitate formation, especially in the combined presence of H_2S or SO_2. Finally, phase behavior and displacement results both suggest that CO_2 flood oil recovery efficiencies will be improved by small additions of H_2S or SO_2, but reduced by small additions of CH_4 or N_2.

0240 Storage

6950 **(PB—82-207515) An introduction to chemiluminescence methods for lubricant oxidation studies. Interim report 19 Mar 81-31 Mar 82.** Clark, D.B.; Weeks, S.J.; Hsu, S.M. (National Measurement Lab. (NBS), Washington, DC (USA)). Apr 1982. 41p. NTIS, PC A03/MF A01.

An introductory review of chemiluminescence (CL) techniques describes applications for the study of oxidation of fuels and lubricants. Reviews of chemiluminescence and oxidation are briefly discussed. The mechanism of CL as it applies to complex hydrocarbon systems is discussed. Several steady state and nonsteady state kinetic methods are discussed with respect to the ability of each technique to give useful information about the kinetics and mechanisms of oxidation. Applications of CL techniques for fuels and lubricants, as well as simple hydrocarbon systems, are discussed. The unique properties of CL methods for materials testing (e.g. lubricant oxidation stability) as well as fundamental understanding of chemical oxidation reactions are emphasized. Studies which evaluate petroleum and synthoil products, oxidation inhibitors and metal catalysts are discussed. Instrumentation capabilities are reviewed and critical features of instrumental design are discussed.

0250 Combustion

REFER ALSO TO CITATION(S) 6887, 6920, 6936, 6961

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 6964

6951 **(DOE/MC/16463—T5) Structural geology of the Moorman syncline area of western Kentucky.** Shumaker, R.C. (West Virginia Univ., Morgantown (USA); Michigan Univ., Ann Arbor (USA)). Jul 1982. Contract AC21-81MC16463. 75p. NTIS (US Sales Only). Order Number DE82022305.

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This geologic report traces the structural development of the Moorman syncline through time, and it is designed to build a background for a remote sensing study of that area from Landsat images. Topics covered include the geologic history of the area and a structural analysis of five major fault zones: the southern Illinois rift, the Wabash fault zone, faults of the Mississippi embayment, the Rough Creek fault zone, and faults of the southern shelf. The importance of Precambrian structural trends and Cambrian rift zones in the basement is emphasized to the subsequent development of surface structure trends. Surface structures are illustrated from published maps and sections, which show a variety of styles from simple extentional normal faults to complex shear zones associated with wrench fault tectonics. Growth movement throughout the Palezoic is an important aspect of the structural development of the area, but the surface structures primarily result from intense deformation during a late Paleozoic deformation and subsequent Mesozoic deformation that emanated from the Mississippi embayment. The distribution of reported earthquakes indicates that the crust within the area is still active. A variety of fracture patterns is expected in sediments associated with the various fault zones. The particular fracture types and their patterns are dependent on the structural style. 45 figures.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 6751, 6928, 6929, 6934

6952 (CONF-8105173—, pp 16p, Paper 12) **Desulphurization of natural gas.** Mueller, R.; Frankholz, G. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

As more than 50 percent of natural gas reserves in the Federal Republic of Germany are sour, purification plants have been erected since the early 1960s. In order to install the most economical and reliable plants according to the different gas compositions, physical and chemical processes are used. The need for removal of organic sulfur is a very important criterion in the selection of the processes. Up to now Purisol, Selexol, Sepasolv, Alkazid and Sulfinol plants are in operation. There are two gas qualities distributed in the Federal Republic of Germany, namely H (high calorific) and L (low calorific) gas. A new development to produce H as well as L gas quality by selective removal of H_2S was made recently. The fully proven Sulfinol process was modified and run in a full-scale test for several months. Generally, the removed H_2S is converted into liquid sulfur in Claus units. In order to meet the stringent tail gas requirements, the selection of the catalyst is of great importance. The optimum solution is to use different types of impregnated catalysts in the three stages. This results in very high sulfur recovery. To comply with environmental protection regulations, BEB/MOBIL OIL installed a tail gas clean-up unit. From the different types for this additional treatment the SCOT-recycling process (no by-product) was chosen. In one year of operation it turned out that the sulfur content of the treated gas was reduced to almost zero. An example for the capital investment in a BEB-operated plant is given in the paper. Furthermore a comparison of specific energy consumption of the different processes is shown. Finally the average manning of BEB-operated plants is discussed.

6953 (CONF-8105173—, pp 3p, Paper 20) **Selective removal of hydrogen sulphide from low-sulphur natural gas with the production of elemental sulphur.** Afanasiev, Yu.M.; Nickolaev, V.Yu.; Brodsky, Yu.N.; Golyand, S.M. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The Soviet Union has many deposits of low-sulphur natural gas containing 0.01 to 0.3 percent ordinary hydrogen sulphide in the presence of carbon dioxide concentrations 10 to 50 times those of hydrogen sulphide. Utilization of the most common alkanolamine method for cleaning natural gas (monoethanolamine or diethanolamine) results in comprehensive removal of both hydrogen sulphide and carbon dioxide from the gas. In the absence of demand for cleaned gas in relation to the carbon dioxide content (with a CO_2 content of about 2 percent), it becomes necessary to explore selective methods for removing hydrogen sulphide from gases, in view of the high cost of using the alkanol-amine method, which is suitable for the recovery of carbon dioxide. Furthermore, the recovered gases have a low hydrogen sulphide content, which makes it difficult to convert them into elemental sulfur. The paper presents a technical and economic comparison of methods for removing hydrogen sulphide up to 5 mg/nm^3, from natural gas containing 0.08 percent H_2S and 2.73 CO_2 (quantity of cleaned gas 3 billion nm^3 a year at a pressure of 56 atm; a comprehensive cleaning method (diethanolamine) and three selective methods (arsenic-sodium, tripotassium phosphate and zeolite) using techniques developed by the State Scientific Research Institute for Gas purification. The technical and economic comparison made according to the methods recommended by ECE show that the most economical one for the circumstances indicated is the tripotassium phosphate method, followed by the zeolite method.

6954 (CONF-8105173—, pp 9p, Paper 33) **Desulphurization of natural gas.** Grulet, L.; Goyot, G. 1981. (In French). NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Natural gas has the reputation of being the non-polluting fuel par excellence. This is because the desulphurization of natural gas during production is a very effective and well-known industrial operation. After reviewing the quantities of sulfur compounds in various types of natural gas and the criteria applicable to purified gas, the report classifies industrial desulphurization procedures and describes their main features. Finally, it gives an idea of the cost of desulphurization, taking as an example gas containing six volumes of H_2S and 10 volumes of CO_2, treatment of which with diethanolamine yields clean gas at a cost of 30.2 francs per 1000 m^3.

6955 **(PB—82-220534) Corrosion studies: geopressured aquifer gas production. Final report 1 Mar 80-27 Feb 81.** Rogers, A.N.; Weekes, M.C.; Schoepflin, F. (Bechtel Group, Inc., San Francisco, CA (USA)). Feb 1981. 95p. NTIS, PC A05/MF A01.

Corrosion test results on a number of metals, exposed to geothermal brines, were incorporated into matrix format to permit a ready comparison of corrosion resistance. The most promising materials were selected for further testing in flowing geopressured brine. The selection was directed toward the use of the materials in a geopressured gas separation system supplied with a brine having a postulated composition based on analyses of four existing geopressured wells and several thousand formation waters. A test plan was developed to determine the corrosion resistance of candidate materials in flowing geopressured brine. A rapid screening by the linear polarization technique is to be followed by a more extended exposure in a test loop. The use of clad or coated carbon steel for the major gas plant components was analyzed. As an alternative, the injection of a small dosage of corrosion inhibitors into the brine was investigated.

0305 Health And Safety

6956 **(PNL—4401) LNG annotated bibliography.** Bomelburg, H.J.; Counts, C.A.; Cowan, C.E.; Davis, W.E.; DeSteese, J.G.; Pelto, P.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC06-76RL01830. 175p. NTIS, PC A08/MF A01. Order Number DE83003623.

This document updates the bibliography published in Liquefied Gaseous Fuels Safety and Environmental Control Assessment Program: third status report (PNL-4172) and is a complete listing of literature reviewed and reported under the LNG Technical Surveillance Task. The bibliography is organized alphabetically by author.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 6923, 6944

0308 Environmental Effects

REFER ALSO TO CITATION(S) 6944

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 6947

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 6958, 6960

6957 **(CONF-8206119—1) Constraints on injection of propane into natural gas transmission lines.** Bodle, W.W.; Scott, M.I. (Institute of Gas Technology, Chicago, IL (USA)). 1982. 16p. Institute of Gas Technology, 3424 South State Street, IIT Center, Chicago, IL 60616.

From 15. world gas conference; Lausanne, Switzerland (14 Jun 1982).

When propane (or a related natural gas liquid) is used to supplement natural gas sendout by direct injection into a transmission line, certain constraints on design and operating variables are necessary to prevent problems of noninterchangeability, condensation, and thermal-stressing of the pipe wall. The paper discusses analytical techniques for assessing each type of problem. 7 figures.

0330 Properties

REFER ALSO TO CITATION(S) 7089

6958 **(PB—82-212184) LNG densities for custody transfer. Final report.** McCarty, R.D. (National Bureau of Standards, Washington, DC (USA)). 1982. 3p. Pub. in Proceedings of International School of Hydrocarbon Measurement (57th), Norman, Oklahoma, April 13-15, 1982, p417-419.

Work has been carried out over the past nine years at the National Bureau of Standards to provide alternate methods for the accurate determination of the density of liquefied natural gas (LNG) that would serve as a basis for equitable custody transfer.

6959 **(PB—82-220609) Computer simulation and molecular theory studies of natural gas mixtures. Annual report 1 Jan 80-31 Dec 80.** Gubbins, K.E. (Cornell Univ., Ithaca, NY (USA)). Jan 1982. 22p. NTIS, PC A02/MF A01.

A new technique has been developed which enables the chemical potential to be calculated accurately in liquid mixtures by computer simulation. Calculations produce activity coefficients and Henry constants with an accuracy of 1-2%. Results have been obtained for highly nonideal mixtures, and have been used to test predictive methods for such mixtures for the first time. The author has also developed simulation methods for studying polar liquids. The perturbation theory equation of state developed in this work has been compared with existing engineering methods, and is found to give much better results for mixtures containing polar fluids, particularly when no mixture data is available. This equation of state has been used to study supercritical fluid equilibria. New correlations for Henry constants for systems with dissolved gases or solids have been developed.

6960 **Enskog correction for size and mass difference effects in mixture viscosity prediction.** Ely, J.F. (NBS, Boulder, CO, USA). *Journal of Research of the National Bureau of Standards (United States);* **86**: No. 6, 597-604(Nov-Dec 1981).

A method is presented which corrects the one-fluid conformal solution viscosity model for size and mass difference effects. This correction, which is based on the Enskog model for hard sphere mixtures, is empirical as applied to transport but has a rigorous basis in equilibrium theory. Comparisons of predictions and experimental viscosities for 24 binary mixtures are presented. 18 refs.

0340 Combustion

REFER ALSO TO CITATION(S) 7892

6961 **(NP—2750314) Energy economy in individual gas heating.** Paulsen, O.; Spiegelhauer, B. (Teknologisk Inst., Tastrup (Denmark)). Nov 1981. 92p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750314.

The efficiency and energy losses of 4 gas boilers has been measured. Results have been used to calculate the yearly energy consumption for some randomly chosen buildings. The investigated boilers had larger permanent energy losses than corresponding oil-fueled ones. However perfect thermal insulation without cold-bridges, automatic flue-gas trap and efficient thermostatic regulation can improve the performance of gas boiler to exceed that of a conventional oil-boiler with a payback period of improvement price about 2 years.

0350 Storage

6962 **(BMFT-FB-T—81-226) Investigations to predict and reduce the evaporation rate of the residual brine in salt caverns used for gas storage.** Petrick, H.J.; Cammenga, H.K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750412.

About 150 tensides have been tested in the laboratory with respect to their ability to reduce the evaporation rate of the residual brine in salt caverns used for gas storage. Fatty alcohols with more than 20 -CH_2- groups and perfluorinated alcohols with more than 12 -CF_2- groups proved especially useful. Further it has been shown that the formation of a solid salt crust on the initially free brine surface is mainly due to the incorporation of alkaline earth ions. After its completion the solid salt crust itself can enormously reduce the evaporation rate of the underlying brine. By the use of different tensides we were able to enhance or retard the crust formation at will. It is highly desirable to try the results gained in this research in the actual performance of salt caverns.

6963 **(RISO-M—2277) Material models for rock salt and calculations for gas and oil storage cavities.** Ottesen, N.S,; Krenk, S. (Risoe National Lab., Roskilde (Denmark)). Nov 1980. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750313.

This report forms of the basis for the establishment of Danish guidelines for the design of underground caverns in salt for natural gas storage. Such guidelines are presently set up by the Danish Energy Agency and the work presented here has been funded by this agency. The report gives a survey of the material behaviour of rock salt and computational aspects of the rock mechanical behaviour of cavities in salt. Interest is concentrated on problems related to cavities used for storage of gas and oil products.

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 6951

6964 **(DOE/DP—0053-1125) Resource and exploration assessment of the oil and gas potential in the Devonian gas shales of the Appalachian Basin.** Zielinski, R.E.; McIver, R.D. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 423p. (MLM-MU—86-61-0002). NTIS (US Sales Only). Order Number DE83003369.

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This report represents a detailed summary of the data from a complete suite of organic geochemical analyses performed on more than 2000 individual core samples as well as several hundred cuttings samples from Devonian Shale wells drilled in the Appalachian Basin. The data were verified, plotted, mapped, and correlated with known production in the basin, and conclusions were drawn. 214 figures, 7 tables.

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 6968

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 6971, 6972, 6979

6965 **(DOE/ET/12072—T13) Technical and economic feasibility of proposed oil-shale beneficiation techniques for surface-retorting processes.** (Fuel and Mineral Resources, Inc., Reston, VA (USA)). 31 Dec 1981. Contract AC01-78ET12072. 151p. NTIS, PC A08/MF A01. Order Number DE83003773.

Portions of document are illegible. Printed copy available until stock is exhausted.

Beneficiation has been identified as a possible technology to mitigate certain environmental impacts related to oil shale development and to have desirable effects on process efficiency and economics. Beneficiation is highly regarded for its potential role in the prevention of pollutant generation at an oil shale facility. If quantities of potential pollutants can be removed with the inorganic mineral fractions of oil shale prior to retorting, this would not only enhance the environmental aspects of an oil shale facility, but the economics might be aided also by decreasing the requirements for extensive pollution control operations. Removal of the non-oil producing inorganic fraction from the oil shale would require less material to be heated per barrel of oil produced. Thermal efficiency of a retorting operation would be improved in this way. Reduction in the volume of material that must be retorted would allow saving in the number or scale of retorting vessels. Possible kerogen concentration techniques were examined for their compatibility to know retorting techniques. Possible retorting concepts were examined to define their respective feedstock size requirements, especially which concepts would lend themselves to utilizing a concentrated fine particle material. From these investigations a general set of specifications defining requirements for a beneficiated product compatible with known retorting methods was prepared. Estimates of the expected performance of the identified potential beneficiation methods compatible with known retorting systems and the associated costs were then made. The results of these investigations were used to identify research needs that are most crucial to effective application of beneficiation techniques.

6966 **(DOE/LC/10440—T7) Site visit report: Enecor Tar Sands Conversion Facility, Salt Lake City, Utah. Final report.** (Versar, Inc., Springfield, VA (USA)). 1982. Contract AC20-80LC10440. 34p. NTIS, PC A03/MF A01. Order Number DE83003603.

Portions of document are illegible. Printed copy available until stock is exhausted.

This report details the activities and equipment used to sample and process feedstock and spent tar sand from the Enecor Tar Sands Conversion Facility in Salt Lake City, Utah. Versar Inc.'s responsibility at this site involved the containerization, labeling, and distribution of solid samples. Distribution of samples was coordinated through the Versar office in Springfield, Virginia; therefore, no detailed description of distribution procedures is given in this report. 4 figures, 1 table.

6967 **(PB—82-214099) The effect of in situ retorting on oil shale pillars. Open file report 28 Jun 76-31 May 81.** Ozdemir, L.; Ropchan, D.; Miller, R.; Wang, F.D.; Sladek, T. (Colorado School of Mines, Golden (USA). Earth Excavation Inst.). Oct 1981. 387p. NTIS, PC A17/MF A01.

An investigation was made to determine the mechanical properties of oil shale at elevated temperatures and confining pressures, the thermal properties at elevated temperatures, and to provide mathematical models for mine design for in situ oil shale retorting. A review of current activity in in situ retorting is included with a comprehensive list of references. Tests were run at temperatures from 20 to 500C and confining pressures to 1,500 psi with shale of 10 to 30 gal per ton.

6968 **(SAND—82-2063) Oil-Shale Program. Twenty-fifth quarterly report, January 1982-March 1982.** Hommert, P.J. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Nov 1982. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01. Order Number DE83003501.

Portions of document are illegible. Printed copy available until stock is exhausted.

The objective has been to acquire the ability to prescribe an efficient process for in situ recovery of a given oil shale resource. The following areas have been under investigation: (1) bed preparation and characterization; (2) retorting process; and (3) structural stability. This report is organized with most of the text under these main headings. However, this separation is somewhat arbitrary and the three areas are not truly independent. The integration of information from the three areas is a vital part of this program. 24 figures, 2 tables.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 6745, 8309

6969 **Heat of combustion of retorted and burnt Colorado oil shale.** Burnham, A.K.; Crawford, P.C.; Carley, J.F. (Lawrence Livermore Natl Lab, CA, USA). *Industrial and Engineering Chemistry Process Design and Development;* **21**: No. 3, 485-489(Jul 1982).

Heats of combustion were measured for 12 samples of retorted and 21 samples of burnt Colorado oil shale originating from raw shales with grades that ranged from 13 to 255 cm/sup 3/ of shale oil/kg of oil shale. For the retorted shales, the authors resolve the heat of combustion into exothermic contributions from combustion of carbon residue and iron sulfides and endothermic contributions from carbonate decomposition and glass formation. Eight samples reported in the literature were included in this analysis. Variations in the first three constituents account for over 99% of the variation in the heats of combustion. For the burnt shales, account must also be taken of the partial conversion of iron sulfides to sulfates. Equations are developed for calculating the heat of combustion of retorted and burnt oil shale with a standard error of about 60 J/g. 13 refs.

6970 **Analysis of oil shale products and effluents using a multitechnique approach.** Fruchter, J.S.; Evans, J.C.; Sanders, R.W.; Wilkerson, C.L. (Pacific Northwest Lab., Memorial Inst., Richland, WA). pp 1-28 of Atomic and nuclear methods in fossil energy research. Filby, R.H.; Carpenter, B.S.; Ragaini, R.C. New York, NY; Plenum (1982).

Inorganic analysis of solid, liquid, particulate, and gaseous samples from the Paraho Semiworks Retort using a multitechnique approach is described. The latter employed a combination of instrumental neutron activation, energy dispersive x-ray flourescence, flame atomic absorption spectroscopy and dc plasma emission spectroscopy. Also used were graphite furnace atomic absorption, cold vapor atomic absorption, and radiochemical activation. The mass balance figures were found to be generally in agreement with previous studies made for a limited number of elements on laboratory-scale or small pilot retorts. Thus, the mass balances reported may have some general validity for other types of oil shale retorting technologies.

6971 **Applications of nuclear magnetic resonance to oil shale evaluation and processing.** Miknis, F.P.; Maciel, G.E. (U.S. Department of Energy, Larmie, WY). pp 349-364 of Atomic and nuclear methods in fossil energy research. Filby, R.H.; Carpenter, B.S.; Ragaini, B.C. New York, NY; Plenum (1982).

The Application and refinement of recently introduced /sup 13/ C NMR techniques for obtaining high resolution spectra of solid materials is disucussed. These techniques show promise for the characterization of fossil fuels. CP/MAS techniques provide important information about the organic carbon distribution in intractable solids. The CP/MAS /sup 13/ C NMR techniques have been applied with great success to a variety of fossil fuel substances. Oil shales and the applications of CP/MAS techniques to oil shale evaluation and processing are discussed. A summary includes the finding that CP/MAS /sup 13/ C NMR techniques provide a direct measurement of the amounts of aliphatic and aromatic carbon types in oil shales. It appears feasible to predict the potential oil yield of an oil shale, and the genetic potential of a formation. The transformation ratio can also be determined. Such measurements can provide insight into organic structural types of carbons that are important for oil shale processing.

6972 **Identification of organic compounds in oil shale retort by GC and GC-MS.** Stuermer, D.H.; Ireland, R.R.; Morris, C.J.; Ng, D.J. (Lawrence Livermore Natl. Lab., Livermore, CA 94550). pp 383-397 of Atomic and nuclear methods in fossil energy research. Filby, R.H.; Carpenter, B.S.; Ragaini, B.C. New York, NY; Plenum (1982).

The organic analysis of oil shale retort water is discussed. A seperation scheme is presented for the analysis by gas chromatography and gas chromatography-mass spectrometry. The scheme is based on liquid-liquid extraction, silica chromatography, argentation chromatography and alumnia chromatography. Resulting fractions can be resolved by chromatography and chromatography-mass spectrometry and several hundred compounds can be identified. A large fraction of retort water contaminants will require new analytical techniques to handle non-volatile and reactive compounds. Discussion concludes that the complete analysis of retort waters is not practical when many samples must be studied. In such cases the analysis of specific individual compounds is a much easier and less time consuming task. Particular compounds or compound classes should be identified for analysis based on the particular problems at hand.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 6979

6973 **(BMFT-FB-T—82-085) Technical study on the possibilities of oil shale combustion in a fluidized bed furnace including cost estimate for a plant to be constructed.** Kuehl, M.; Steller, P. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750729.

The goal of this technical study is to draft an overall concept of oil shale combustion in a fluidized bed furnace, establishing the final plant size, allowing a scale-up of 200 t/h steam. Moreover the concept will be technically revised for a cost estimate of +- 15% accuracy, establishing the estimate.

0407 Health And Safety

6974 **Acute cytotoxicity of fossil-energy-related comparative research materials.** Schultz, T.W. (Oak Ridge Natl Lab, TN, USA). *Journal of Environmental Science and Health, Part A: Environmental Science and Engineering;* **A17**: No. 2, 153-167(1982).

Aqueous extracts of five fossil-energy-related comparative research materials have been examined under acute static conditions for toxic effects by use of the Tetrahymena assay system. Cells were exposed to various concentrations of extracts, and cytolysis and population growth impairment were monitored. In addition, chemical class fractionation and major organic elemental analysis were performed. Synthetic fossil fuel materials are more toxic than conventional petroleum crude oils and coal-derived materials are more toxic than crude shale oil. Synthetic fossil-fuel-related materials have a higher nitrogen and oxygen content and a greater aromaticity than do natural crude oils. Acute toxicity appears to be correlated with ether-soluble acid content, mono- and diaromatic hydrocarbon content, and ether-soluble base. 22 refs.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 6966, 6970, 6980

6975 **(DOE/ET/12072—T15) Critical review, comparative evaluation, cost update, and baseline data development services in oil shale mining, in-situ liquefaction, and above ground retorting processes from the environmental, permitting, and licensing viewpoints. Volume III. Emission source identification and source-specific pollution control applications. Part 1.** (Fuel and Mineral Resources, Inc., Reston, VA (USA)). 1 May 1981. Contract AC01-78ET12072. 252p. NTIS, PC A12/MF A01. Order Number DE83003775.

Portions of document are illegible. Printed copy available until stock is exhausted.

The present volume is the third major deliverable of the title study. The document accomplished two objectives: (1) It identifies all major emission sources within an integrated flowsheet of oil shale operations encompassing mining, preparation, retorting, and upgrading; and (2) It delineates the logic process for selecting and instigating source-specific pollution controls, selected among all currently commercially available options. Specific pollutants dealt

with in the present Volume III are sulfur species, (H_2S and SO_2 primarily), particulates, fugitive dust, and arsenic species. The present Volume III is divided into two separate Parts. Part 1 covers: (1) Sulfur species (H_2S and SO_2); (2) Particulates and fugitive dust; and (3) Arsenic. Retort off-gas control processes considered include: MDEA; Benfield Process; Physical absorption systems; Sulfinol Process; and The Holmes-Stretford Process. Processes considered for the control of SO_2 in flue gas are: Wellman-Lord Process; Limestone Slurry Process; Lime Slurry Process; Chiyoda Thoroughbred 121; Lime Slurry Spray Dryer/Fabric Filter Process; Resox Process; Magnesia Slurry Process; Double Alkali Process; Citrate/Phosphate Absorption Process; Ammonia-Ammonium Bisulfite Process; IFP Process; Activated Carbon Process; Catalytic Oxidation processes; Shell/UOP Copper Oxide Process; and Davy S-H Process. For removal of dusts and particulates, cyclones, electrostatic precipitators, afterburners, scrubbers, mist eliminators, fabric filters and sonic agglomeration are evaluated. Wastewater, off-gas, and product oil controls for arsenic removal are also presented. (DMC)

6976 **(DOE/ET/12072—T17) Critical review, comparative evaluation, cost update, and baseline data development services in oil-shale mining, in-situ liquefaction, and aboveground retorting processes from the environmental, permitting, and licensing viewpoints. Volume II. Oil-shale industry pollutant control technology.** (Fuel and Mineral Resources, Inc., Reston, VA (USA)). 28 Jan 1981. Contract AC01-78ET12072. 267p. NTIS, PC A12/MF A01. Order Number DE83003774.

Portions of document are illegible. Printed copy available until stock is exhausted.

The present volume is the second major deliverable of the title study. This volume is organized into three parts: (A) Gaseous Effluents Control Technology and Sewage Engineering: (B) Liquid Effluents Control Technology and Sewage Engineering; and (C) Solid Waste Disposal Technology. In Part A, the key types of gaseous effluents and particulates controls are qualitatively described. These types of controls are: Baghouses; Cyclones; Wet Collection Devices; Water Sprays; and Electrostatic Precipitation. In addition to the above control technologies applicable in general to most gaseous effluents and particulates, specific treatment has been given to the control technologies particularly applicable to three specific gaseous pollutants of great concern to the oil shale industry. These pollutants are: Hydrocarbons; NO/sub x/; and Sulfur. Part B qualitatively describes the key types of control technologies applicable to liquid effluents. These technologies are: Ion Exchange; Precipitation and Coagulation (Flocculation); Distillation; Steam Stripping; Sedimentation; Filtration; Adsorption; Reverse Osmosis; Flotation; Air Stripping Ammonia Removal; Stabilization Ponds; Chemical Oxidation; Biological (Trickling) Filtration; Activated Sludge; and Nitrogen (Ammonia) Wastewater Controls. A systematic effort was made in the description of each technology to address two key issues: Operating principles of the controls method and field of applications of the controls method. The Part C of the present study focuses on technologies applicable to treatment of hazardous solid wastes. Again, operating principles and field of application are discussed, whereas numerical performance data are omitted.

6977 **(DOE/ET/12072—T18) Critical review, comparative evaluation, cost update, and baseline data development services in oil-shale mining, in-situ liquefaction, and aboveground retorting processes from the environmental, permitting, and licensing viewpoints. Volume III. Emission-source identification and source-specific pollution-control applications. Part 2 .** (Fuel and Mineral Resources, Inc., Reston, VA (USA)). 18 Sep 1981. Contract AC01-78ET12072. 404p. NTIS, PC A18/MF A01. Order Number DE83003776.

Portions of document are illegible. Printed copy available until stock is exhausted.

This volume is the third major deliverable of the title study. The document accomplishes two objectives: (1) It identifies all major emission sources within an integrated flow-sheet of oil shale operations encompassing mining, preparation, retorting, and upgrading; and (2) It delineates the logic process for selecting and instigating source-specific pollution controls, selected among all currently commercially available options. Volume III is divided into two separate parts. Part II covers mercury; trace metals; carbon monoxide; NO/sub x/; and hydrocarbons. Mercury waste water control technologies discussed include ion exchange, starch complexing, ferrite coprecipitation, evaporation ponds, sulfide precipitation, activated carbon, and specific control processes. Trace metal control processes in waste water discussed include reverse osmosis, starch complexing, sodium borohydride, hydroxide precipitation, ferrite coprecipitation, ion exchange, activated carbon, sulfide precipitation, evaporation ponds, and combined physical-chemical metal removal. Offgas system removal of beryllium, cadmium, chromium, lead, and selenium are also covered. Carbon monoxide control technologies in utility and industrial boilers and in petroleum refineries are covered. Flue gas denitrification processes discussed included noncatalytic and catalytic reduction, adsorption, oxidation, alkalized alumina, electron beam radiation, activated carbon process for NO/sub x/ removal. Hydrocarbon control technologies in waste water and gases are described. (DMC)

6978 **(PNL-SA—10598) Oil-shale solid-waste disposal: estimation of embankment physical stability and the movement of water and solutes.** Wildung, R.E.; Bond, R.; Gee, G.; Nelson, J.D. (Pacific Northwest Lab., Richland, WA (USA); Colorado State Univ., Fort Collins (USA). Dept. of Civil Engineering). Jul 1982. Contract AC06-76RL01830. 43p. (CONF-820892—2). NTIS, PC A03/MF A01. Order Number DE83002006.

From Oil Shale Task Force conference; Vail, CO, USA (9 Aug 1982).

This paper reviews the basic principles governing the physical stability and the movement of water in a retorted shale embankment. A hydrologic model was used to estimate water movement in a conceptual embankment subjected to a hypothetical, simplified construction and closure scenarios and a 30 year climatic exposure. The benefits and limitations of the approach are described in conjunction with research required to achieve more precise estimates of physical stability, and water and solute movement.

6979 **Preparation and injection of grout from spent shale for stabilization of abandoned in-situ oil shale retorts.** Mallon, R.G. (Lawrence Livermore Natl Lab, CA, USA). *Journal of Petroleum Technology;* **34**: No. 7, 1609-1613(Jul 1982).

A procedure has been developed for stabilizing abandoned in-situ oil shale retorts by means of high-temperature treatment of surface-processed shale, followed by grinding, mixing with water, and injection underground. Laboratory results indicate that abandoned in-situ retorts can be made strong enough to prevent subsidence and sufficiently impermeable to reduce groundwater flow greatly. The underground injection also reduces the amount of spent-shale disposal on the surface. 12 refs.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 6975, 6978

6980 **(DOE/ET/12072—T20) Source terms for the health and environmental effects document (HEED) for oil shale: 1982.** (Fuel and Mineral Resources, Inc., Reston, VA (USA)). 24 May 1982. Contract AC01-78ET12072. 189p. NTIS, PC A09/MF A01. Order Number DE83003771.

Portions of document are illegible. Printed copy available until stock is exhausted.

The purpose of this document is to provide revised Source Term data input for updating the existing Oil Shale HEED data base. The document presents industry-generated data on source terms for air emissions, water effluent constituents, and solid waste pollutants associated with selected oil shale processing facilities. This document addresses those oil shale processing facilities which have submitted Prevention of Significant Deterioration, National Pollutant Discharge Elimination Systems, and State Mining and Land Reclamation Permit Applications that are currently approved or under review. Also this document provides detailed back-up documentation for data presented in the summarized tables and data gaps identified during the study.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 7513

0502 Exploration

6981 (GJBX—145-82) Evaluation of uranium geochemical anomalies in the Kings Mountain area, Charlotte 1° x 2° Quadrangle. National Uranium Resource Evaluation Program. Sargent, K.A.; Price, V. Jr.; Karfunkel, B.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1982. Contract AC13-76GJ01664. 85p. (DPST—81-141-13). NTIS (US Sales Only). Order Number DE82018509.

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The Savannah River Laboratory (SRL) was involved in the National Uranium Resource Evaluation (NURE) from 1974 through 1981. The SRL role was to design, conduct, and report the data from a geochemical reconnaissance of almost half the continental United States. The purpose of the work was to provide a basis for evaluating the uranium potential of areas and to identify areas meriting conventional geologic followup. In this program, more than 275,000 samples of stream sediment, soil, vegetation, and ground or surface water were collected. As a part of the development program to support interpretation of the geochemical data, SRL evaluated a series of geochemical anomalies identified by reconnaissance data. Subcontractors were selected to conduct field scintillometer surveys, compile geologic maps, collect additional samples, or provide other services required for a given study. This report summarizes the results of a study in the Charlotte 1° x 2° quadrangle, based on data from the hydrogeochemical and stream sediment reconnaissance. The study includes a geologic report and map prepared for SRL by David E. Howell; chemical analyses of individual monazite and zircon grains from stream sediments in the study area; and analyses of three zircon grains from near Antreville, South Carolina. Normal editing of the report was not possible before the termination of the NURE program. Thus, typographical and conceptual errors that may be present have not been corrected, and the reader is cautioned to use professional judgement in interpreting the data. 29 figures, 9 tables.

6982 (GJBX—225-82) Uranium resources in fine-grained carbonaceous rocks of the Great Divide Basin, south-central Wyoming. National Uranium Resource Evaluation. Burger, J.A.; Roe, L.M. II; Hacke, C.M.; Mosher, M.M. (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). Nov 1982. Contract AC13-76GJ01664. 173p. NTIS PCE08/MF $4.75. Order Number DE83003097.

Portions of document are illegible. Includes 6 sheets of 24x reduction microfiche.

The uranium resources of the fine-grained carbonaceous rocks of the Great Divide Basin in southern Wyoming were assessed. The assessment was based primarily on data from some 600 boreholes. The data included information from geophysical logs, lithologic logs and cores, and drill cuttings. The cores and cuttings were analyzed for chemical U_3O_8, radiometric U, Th and trace elements. Selected samples were examined by thin section, sieve analysis, x-ray, SEM, ion probe, and alpha track methods. The uranium is associated with fine-grained carbonaceous shales, siltstones, mudstones, and coals in radioactive zones 5 to 50 ft thick that are continuous over broad areas. These rocks have a limited stratigraphic range between the Red Desert tongue of the Wasatch Formation and the lower part of the Tipton tongue of the Green River Formation. Most of this uranium is syngenetic in origin, in part from the chelation of the uranium by organic material in lake-side swamps and in part as uranium in very fine detrital heavy minerals. The uraniferous fine-grained carbonaceous rocks that exceed a cutoff grade of 100 ppM eU_3O_8 extend over an area of 542 mi^2 and locally to a depth of approximately 2000 ft. The uraniferous area is roughly ellipical and embraces the zone of change between the piedmont and alluvial-fan facies and the lacustrine facies of the intertonguing Battle Spring, Wasatch, and Green River Formations. About 1.05 x 10^6 tons U_3O_8, based on gross-gamma logs not corrected for thorium, are assigned to the area in the first 500 ft; an estimated 3.49 x 10^6 tons are assigned to a depth of 1000 ft. These units also contain a substantial thorium resource that is also associated with fine-grained rocks. The thorium-to-uranium ratio generally ranges between 1 and 4. A thorium resource of 3.43 x 10^6 tons to a depth of 500 ft is estimated for the assessment area. 5 figures, 3 tables.

6983 (KFK-AFR—003) Seminar on radionuclide technology. Abstracts. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Arbeitsgemeinschaft zur Foerderung der Radionuklidtechnik; Verein Deutscher Ingenieure (VDI) - Gesellschaft Verfahrenstechnik und Chemieingenieurwesen (GVC), Duesseldorf (Germany, F.R.). Fachausschuss Radioisotope in der Verfahrenstechnik; Gesellschaft Deutscher Chemiker, Frankfurt am Main (Germany, F.R.). Arbeitskreis Radioanalytik). May 1981. 58p. (In German). (CONF-8105158—Absts.). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82780794.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

Separate abstracts have been prepared for items within scope for inclusion in the Energy Data Base.

6984 (KFK-AFR—003, pp 19) Investigation of uranium rearrangement processes in Pre-Cambrian sediments. Thiel, K.; Saager, R.; Hennig, G.J.; Bangert, U.; Herr, W. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

6985 (PGJ/F—056-82) National Uranium Resource Evaluation: Moab Quadrangle, Colorado and Utah. Campbell, J.A.; Franczyk, K.J.; Lupe, R.D.; Peterson, F. (Geological Survey, Golden, CO (USA)). Sep 1982. Contract AI13-78GJ01686. 150p. NTIS PCE09/MF $7.25. Order Number DE83001220.

Portions of document are illegible. Includes 15 sheets of 24x reduction microfiche.

Portions of the Salt Wash Member of the Morrison, the Chinle, the Rico, the Cutler, and the Entrada Formations are favorable for uranium deposits that meet the minimum size and grade requirements of the US Department of Energy within the Moab 1' x 2' Quadrangle, Utah and Colorado. Nine areas are judged favorable for the Late Jurassic Salt Wash Member. The criteria used to evaluate these areas as favorable include the presence of (1) fluvial sandstone beds deposited by low-energy streams; (2) actively moving major and minor structures such as the Paradox basin and the many folds within it; (3) paleostream transport directions approximately perpendicular to the trend of many of the paleofolds; (4) presence of favorable gray lacustrine mudstone beds; and (5) known uranium occurrences associated with the favorable gray mudstones. Three favorable areas have been outlined for the Late Triassic Chinle Formation. The criteria used to evaluate these areas are the sandstone-to-shale ratios for the Chinle Formation and the distribution of the Petrified Forest Member of the Chinle, which is considered the source for the uranium. Two favorable areas have been delineated for the Permian Cutler Formation, and one for the Permian Rico Formation. The criteria used to outline favorable areas are the distribution of favorable facies within each formation. Favorable facies are those that are a result of deposition in environments that are transitional between fluvial and marine. One favorable area is outlined in the Jurassic Entrada Sandstone in the southeastern corner of the quadrangle in the Placerville district. Boundaries for this area were established by geologic mapping.

0503 Mining

REFER ALSO TO CITATION(S) 8348

0504 Feed Processing

REFER ALSO TO CITATION(S) 7009

6986 **(KFK-AFR—003, pp 20) Separation of uranium from sea water.** Lieser, K.H.; Gleitsmann, B.; Burba, P. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

6987 **(MIT-EL—82-037) Uranium from seawater research. Final progress report, FY 1982.** Borzekowski, J.; Driscoll, M.J.; Best, F.R. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Sep 1982. Contract AM01-76EI02295. 50p. (MITNE—254). NTIS, PC A03/MF A01. Order Number DE83002477.

Portions of document are illegible.

During the FY 1982 campaign 14 new ion exchange resin formulations, prepared by the Rohm and Haas Company, were tested by MIT at the Woods Hole Oceanographic Institution. The best of these chelating resins was again of the acrylic amidoxime type; it picked up approximately 100 ppM uranium in seven days' exposure to seawater, which represents a factor of better than two improvement over the seven-day results for the best FY 1981 candidate (which saturated at roughly 100 ppM U after 30 days' exposure). Saturation was not reached and, within experimental accuracy, uranium accumulated at a constant rate over the seven-day period; it is speculated that a useful capacity of over 300 ppM U would be achieved. All resins of the styrenic amidoxime type were found to be an order of magnitude lower in their effective capacity for uranium in seawater than the best of the acrylic forms. Particle size effects, which were found to be less than expected from theoretical computations of both fluid and solid side mass transfer resistance, can not account for this difference. Scanning electron microscope examination by R and H scientists of ion exchange resin beads from beds subjected to seawater flow for 30 days in MIT's WHOI columns showed that the internal pores of the macro-reticular-type resins become filled with debris (of undetermined nature and effect) during exposure.

0505 Enrichment

REFER ALSO TO CITATION(S) 8879

6988 **(KFK—3310) Development and technical implementation of the separation nozzle process for enrichment of uranium-235.** Becker, E.W.; Bier, W.; Bley, P.; Ehrfeld, W.; Schubert, K.; Seidel, D. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Kernverfahrenstechnik). Mar 1982. 30p. (CONF-820202—18). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750663.

From AICHE 1982 national winter meeting; Orlando, FL, USA (28 Feb 1982).

The separation nozzle process developed by the Karlsruhe Nuclear Research Center relies on the centrifugal force in a curved jet consisting of uranium hexafluoride and a light auxiliary gas. It is applied on a technical scale in Brazil. There a cascade section consisting of 24 separation stages is being constructed which will be extended in two steps into a demonstration plant with a capacity of roughly 300 000 SWU/year. To produce separation nozzle systems with extremely small characteristic dimensions permitting plant operation at atmospheric pressure, a manufacturing process is being developed which relies on combined X-ray lithography and microgalvanic deposition (LIGA-technology). By applying this technology the prototype separation stages being constructed at the Karlsruhe Nuclear Research Center allow to realize commercial separation nozzle plants with capacities between one and four million SWU/year. Less than 300 separation stages are required to cascades with a product assay of 3.2% and a tails assay of 0.25% ^{235}U. A cost evaluation is given for such plants.

6989 **(KFK—3336) Separation nozzle method for enrichment of the light uranium isotope.** Becker, E.W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik). May 1982. 16p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750989.

The history of the development of the separation nozzle method for enrichment of the light uranium isotope is described as a contribution to a memorandum published by Deutsche Forschungsgemeinschaft. The work was triggered off by an effect which had been observed in fundamental studies on gas kinetics. Development up to the technical maturity covered a period of more than 25 years. The implementation of the project at the Karlsruhe Nuclear Research Center provided an adequate financial and technical framework, the employment of senior staff without limitations in time being of major importance for the continuity of work. The links established between the Institute and the University and the resulting opportunity of having doctoral theses written, on the other hand, gave rise to a permanent flow of young, highly qualified scientists and engineers. Thus the Institut's requirements for junior staff could be satisfied in an optimum way. Although the Center offered a variety of possibilities of internal technical cooperation, important developments were performed jointly with industrial firms experienced in related fields. By this, not only a steady flow of know-how had been accumulated but also the large-scale applicability was ensured at a later date of results jointly obtained.

6990 **(MPQ—44) Contribution to the future prospects of laser separation of uranium isotopes.** Becker, F.S. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Apr 1981. 147p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750413.

In the past several years, the selective absorption of laser light has been considered as an alternative to the large-scale technical uranium isotope separation schemes based on the mass-dependence of the diffusion velocity or the centrifugal force. An analysis of the published results appears to show that two-frequency multiphoton dissociation is especially attractive for a technical process. To clarify the prospects of such a scheme, studies of the isotope selectivity of the multiphoton dissociation of statically cooled UF_6 with two infrared frequencies, one of which is tunable in the region of the UF_6 $\nu(3)$ band at 16 μm, are proposed. The construction and testing of a high-power laser, tunable in the 16 μm region, based on the frequency conversion of 10 μm CO_2 radiation by means of stimulated rotational Raman scattering in para-hydrogen, is described. Pulse-widths of about 80 nsec and pulse energies of about one half J are obtained which ought to permit, in combination with a CO_2 laser, the multiphoton dissociation of UF_6 without focussing. By means of UV-light experiments it is shown that optical dissociation of UF_6 can be obtained even in the presence of high F-concentrations, thus permitting a high dissociation yield without a F-scavenger which could negatively affect the isotope selectivity.

6991 **(UCRL—88040) Atomic-vapor-laser isotope separation.** Davis, J.I. (Lawrence Livermore National Lab., CA (USA)). Oct 1982. Contract W-7405-ENG-48. 7p. (CONF-821011—16). NTIS, PC A02/MF A01. Order Number DE83003253.

From IEEE nuclear science symposium; Washington, DC, USA (20 Oct 1982).

This paper gives a brief history of the scientific considerations leading to the development of laser isotope separation (LIS) processes. The close relationship of LIS to the broader field of laser-induced chemical processes is evaluated in terms of physical criteria to achieve an efficient production process. Atomic-vapor LIS processes under development at Livermore are reviwed. 8 figures.

6992 **Apparatus for shifting the wavelength of light.** McCulla, W.H.; Allen, J.D. Jr. (to Dept. of Energy). US Patent Application 343,802. 29 Jan 1982. 10p. Contract W-7405-ENG-26.

This invention, which resulted from a contract with the United States Department of Energy, relates to a means for shifting the wavelength of light and, more particularly, to a means for

changing the wavelength of a laser beam so that the beam can be effectively used in a process for separation uranium isotopes. As disclosed in US Patent 3,940,615, ^{235}U can be separated from ^{238}U by selectively ionizing the ^{235}U isotope in a vapor containing both ^{235}U and ^{238}U, this ionization being effected by passing a laser beam having a proper frequency (or wavelength) through the vapor. Doppler shifting of the wavelength of a laser beam to obtain an optimal light wavelength for ionizing ^{235}U in such a separation process has been proposed heretofore. However, the applicants are aware of no apparatus for Doppler shifting of the wavelength of light that has the features or advantages of apparatus constructed in accordance with the principles of their invention. A light beam is reflected back and forth between a rotating body having a retroreflection corner at opposite ends thereof and a fixed mirror to change the wavelength of the light beam by the Doppler effect.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 7057, 7068, 7490, 7512, 7630, 8124

6993 **(LA—9555-MS) Multiple sampling of a plutonium-metal button.** Bruckner, L.A. (Los Alamos National Lab., NM (USA)). Oct 1982. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01. Order Number DE83002951.

Portions of document are illegible. Printed copy available until stock is exhausted.

Fifteen samples were taken from a plutonium metal button and submitted for chemical and isotopic analyses. The button was found to be quite homogeneous with respect to the isotopes and, if one sample was omitted, with respect to plutonium. There was some indication of americium segregation. The analytic techniques produced values whose variances were consistent with the currently used variance estimates for all the isotopes and for plutonium, but not for americium. 4 figures, 4 tables.

6994 **Quantitative differential thermal analysis study of the U/sub 3/O/sub 8/-Al thermite reaction.** Pasto, A.E.; Copeland, G.L.; Martin, M.M. (Oak Ridge Natl Lab, TN, USA). *American Ceramic Society Bulletin;* **61**: No. 4, 491-496(Apr 1982).

Concerns about proliferation resistance of nuclear fuels and fuel cycles have prompted a reinvestigation of U/sub 3/O/sub 8/-Al cermet fuels currently being used in research and test reactors. In particular, higher loadings of U/sub 3/O/sub 8/ are being considered. These new fuel compositions are in the region of maximum possible thermal energy release from the high temperature thermite reaction between the U/sub 3/O/sub 8/ and aluminum components. The present study was initiated to measure the amount of reaction heat evolved quantitatively. A differential thermal analysis system was calibrated with materials of known heats of reaction. Subsequently, specimens of high uranium-load U/sub 3/O/sub 8/-Al powder mixtures were analyzed. Preliminary results showed that the thermite reaction heat evolved from these specimens was much lower than expected. Specimens of simulated fuel plates showed similar low results. Possible reasons for this behavior are discussed. 18 refs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 7005, 7008, 7065, 7068, 7069, 7667, 8226

6995 (GRS—19(8-80), pp 631-644) **Analysis of process signals in nuclear installations.** Avenhaus, R.; Spannagel, G. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

In the framework of the 'Project of Reprocessing and Waste Treatment' of the Karlsruhe Nuclear Research Center, some time ago an activity has been initiated, the aim of which is to detect, in time, disturbances of production processes of nuclear installations with the help of process-signal analysis. In this paper, the present state of this activity is described. Firstly, the basic approach will be discussed: by means of appropriate process models it is demonstrated which behaviour of the process will lead to which signals; vice versa, the investigations of these signals by decision theoretical methods will provide information on possible disturbances of the process. Secondly, the influence of process variations on the decision procedure will be discussed in some detail. Implementation of this procedure in the WAK is underway.

6996 **(LA—9464-MS) Salt stripping: a pyrochemical approach to the recovery of plutonium electrorefining salt residues.** Christensen, D.C.; Mullins, L.J. (Los Alamos National Lab., NM (USA)). Oct 1982. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01. Order Number DE83002914.

A pyrochemical process has been developed to take the salt residue from the plutonium electrorefining process and strip the plutonium from it. The process, called salt stripping, uses calcium as a reducing/coalescing agent. In a one-day operation, greater than 95% of the plutonium can be recovered as a metallic button. As much as 88% of the residue is either reused as metal or discarded as a clean salt. A thin layer of black salts, which makes up the bulk of the unrecovered Pu, is a by-product of the initial reductions. A number of black salts can be collected together and re-reduced in a second step. Greater than 88% of this plutonium can be successfully recovered in this second stage with the resulting residues being discardable. The processing time, number of processor hours, and the volume of secondary residues are greatly reduced over the classical aqueous recovery methods. In addition, the product metal is of sufficient quality to be fed directly to the electrorefining process for purification. 8 figures, 7 tables.

6997 **Method of increasing the deterrent to proliferation of nuclear fuels.** Rampolla, D.S. (to Department Of Energy). US Patent 4,344,912. 17 Aug 1982. Filed date 16 Jun 1980. vp.

PAT-APPL-159891.

A process is claimed of recycling protactinium-231 to enhance the utilization of radioactively hot uranium-232 in nuclear fuel for the purpose of making both fresh and spent fuel more resistant to proliferation. The uranium-232 may be obtained by the irradiation of protactinium-231 which is normally found in the spent fuel rods of a thorium base nuclear reactor. The production of protactinium-231 and uranium-232 would be made possible by the use of the thorium uranium-233 fuel cycle in power reactors.

6998 **Face seal assembly for rotating drum.** Morgan, J.; Rennich, M.J.; Whatley, M.E. (to Dept. of Energy). US Patent 4,343,478. 10 Aug 1982. Filed date 13 Mar 1981. vp.

PAT-APPL-243395.

A seal assembly comprises a tube rotatable about its longitudinal axis and having two longitudinally spaced flanges projecting radially outwardly from the outer surface thereof. Slidably positioned against one of the flanges is a seal ring, and disposed between this seal ring and the other flange are two rings that are forced apart by springs, one of the latter rings being attached to a flexible wall.

6999 **Criticality safety in the ICPP Rover fuel dissolution system.** Fast, E. (Exxon Nuclear Idaho Co., Inc., P.O. Box 2800, Idaho Falls, ID 83401). *Transactions of the American Nuclear Society;* **41**: 345-347(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

0509 Transport And Storage

REFER ALSO TO CITATION(S) 7040

7000 **(EGG-M—25882) Model for analyzing demand for low-level waste transport containers - regionalized and non-regionalized scenarios.** Nelson, A.J.; Rose, K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1982. Contract AC07-76ID01570. 12p. (CONF-821012—3). NTIS (US Sales Only). Order Number DE83002995.

From Institute for management sciences/Operations Research Society of America joint meeting; San Diego, CA, USA (25 Oct 1982).

Certain types of low-level radioactive waste (LLW) must be shipped in expensive special containers. It is therefore desirable to keep container utilization high. There must be a stock of containers sufficient to ship waste in a timely fashion, but one does not want to have containers sitting idle a significant fraction of the time. A computerized discrete event network model has been developed and is described in this report. The model allows an analyst to determine the effects of varying the increase in LLW, establishment of regional disposal, etc. on requirements for shipping containers.

7001 **(PNL—4533) Spent-fuel dry-storage testing at E-MAD (March 1978-March 1982).** Unterzuber, R.; Milnes, R.D.; Marinkovich, B.A.; Kubancsek, G.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Sep 1982. Contract AC06-76RL01830. 565p. (AESD-TME—3162). NTIS, PC A24/MF A01. Order Number DE83002966.

Portions of document are illegible. Printed copy available until stock is exhausted.

From March 1978 through March 1982, spent fuel dry storage tests were conducted at the Engine Maintenance, Assembly and Disassembly (E-MAD) facility on the Nevada Test Site to confirm that commercial reactor spent fuel could be encapsulated and passively stored in one or more interim dry storage cell concepts. These tests were: electrically heated drywell, isolated and adjacent drywell, concrete silo, fuel assembly internal temperature measurement, and air-cooled vault. This document presents the test data and results as well as results from supporting test operations (spent fuel calorimetry and canister gas sampling).

7002 **Nuclear waste transportation.** Luna, R.E.; Jefferson, R.M.; Pope, R.B.; Allen, G.C. (Sandia National Labs., Albuquerque, NM). *Underground Space;* 6: No. 4-5, 264-271(Jan 1982). Contract AC04-76DP00789.

The complete process of nuclear waste transportation is considered from a discussion of the basic concepts under which the movement of radioactive materials occurs to the specifics of what transportation system might be used to carry the waste materials to a repository. Discussion of the way that transport operations are conducted and the manner in which an emergency response might be accomplished are included also. With developing technology, it is pointed out that transportation of nuclear wastes should become even safer; however, shipping of waste materials under the program developed under the existing framework of regulations has been accomplished without a death or serious radioactive exposure for over 30 years. (BLM)

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 6923

0520 Waste Management

REFER ALSO TO CITATION(S) 7061, 7062, 7063, 7073, 7074, 7512, 7667, 8007, 8100, 8231, 8318, 8470

7003 **(GSF-T—119) Studies on type and amount of water in the mineral salt of Zechstein; release and migration in the temperature field of final storage sites of radioactive waste.** Jockwer, N. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen (Germany, F.R.). Inst. fuer Tieflagerung; Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Natur- und Geisteswissenschaften). 15 Jun 1981. 143p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82751050.

Thesis.

The direct effect of heat producing waste on the natural salt rock and the minerals it contains as well as its water components have been examined. For the calculations of the amount of water which runs into the boreholes and probably cumulates during the years the equilibrium between boreholes and void spaces is of importance.

7004 **(INIS-mf—7223) Nordic symposium on reactor waste. Abstracts.** Edwall, B. (ed.). (Swedish Nuclear Fuel Supply Co., Stockholm; Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). 1982. 30p. (CONF-8109178—Absts.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83780105.

From Nordic symposium on reactor waste; Kungaelv, Sweden (14 Sep 1981).

Individual items are included in the data base.

7005 **(Juel—1765) Safety-engineering studies and safety analysis of methods for storage or disposal of Kr-85 separated from the dissolver off-gas of a LWR fuel reprocessing plant.** Niephaus, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie). Feb 1982. 178p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750987.

Thesis. Submitted to Technische Hochschule Aachen, Germany, F.R.

In this report results of experimental and literature studies concerning safety, technical and radiological aspects of longterm storage and deep-sea disposal of cylinders filled with compressed Krypton-85 retained in a fuel reprocessing plant are presented.

7006 **(KFK—3221) Decay calculations on medium-level and actinide-containing wastes from the LWR fuel cycle. Pt. 1. Basic data evaluation including activity and thermal decay power.** Haug, H.O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Oct 1981. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750338.

A number of basic data on medium-level and actinide-containing waste streams from the LWR fuel cycle were evaluated and the activity and thermal decay power were calculated for the nuclide inventories of cladding hulls and fuel assembly structural materials, for feed clarification sludge, medium-level aqueous process waste, low-level solid transuranium waste and for medium-level reactor operating waste. The activity as a function of decay time of the medium-level wastes decreases within 500 to 600 years by 1 to 3 orders of magnitude and is at the same time about 1 to 2 orders of magnitude lower than the activity of the high-level waste. The thermal decay power of the medium-level wastes decreases after 10 to 100 years by about 3 orders of magnitude and is about a factor of 10 to 100 less than that of high-level waste. In the very long term the residual activity (and thermal power) decreases only slowly due to the long halflives of the dominant actinides. The activity after more that 1000 years is about 1 to 2 orders of magnitude lower than that of high-level waste, the low-level transuranium waste by a factor 10 to 4, respectively. The activity per unit volume of the packaged waste of the medium-level and actinide-containing wastes because of the bigger volume of the conditioned wastes is lower by 2 to 4 orders of magnitude up to about 500 years. After more than 1000 years the activities per unit volume are lower by a factor of 20 to 200 than that of high-level waste.

7007 **(KFK—3251e) Preparation and characterization of an improved borosilicate glass for the solidification of high level radioactive fission product solutions (HLW). Pt. 2.** Kahl, L.; Ruiz-Lopez, M.C.; Saidl, J.; Dippel, T. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Apr 1982. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750740.

In the 'Institut fuer Nuklare Entsorgungstechnik' the borosilicate glass VG 98/12 has been developed for the solidification of the high level radioactive waste (HLW). This borosilicate glass can be used in a direct heated ceramic melter and forms together with the HLW the borosilicate glass product GP 98/12. This borosilicate glass product has been examined in detail both in liquid and solid state. The elements contained in the HLW can be incorporated without problems. Only in a few exceptions the concentration must

be kept below certain limits to exclude the formation of a second phase ('yellow phase') by separation. No spontaneous crystallization and no crystallization over a long time could be observed as long as the temperature of the borosilicate glass product is kept below its transformation area. Simulating accidental conditions in the final storage, samples had been leached at temperatures up to 200°C and pressures up to 130 bar with saturated rock salt brine and saturated quinary salt brine. The leaching process seems to be stopped by the formed 'leached layer' on the surface of the borosilicate glass product after a limited leaching time. Detailed investigations have been started to explain this phenomenon.

7008 **(KFK—3314) Adsorption of gas mixtures on molecular sieves.** Godoy, M.L.; Franz, G.; von Ammon, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Apr 1982. 59p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750738.

The dynamic coadsorption of 10 binary gas mixtures and one ternary mixture on molecular sieve 10A was studied at room temperature. The single components are: N_2O, NO, NO_2, NH_3, CO_2, and H_2O. These gases are components of the dissolver off-gas of reprocessing plants for spent nuclear fuels and reach an adsorber bed installed in the off-gas purification system.

7009 **(LA—9397-MS) Evaluation of environmental-control technologies for commercial nuclear fuel-conversion (UF_6) facilities.** Perkins, B.L. (Los Alamos National Lab., NM (USA)). Oct 1982. Contract W-7405-ENG-36. 65p. NTIS, PC A04/MF A01. Order Number DE83002918.

Portions of document are illegible. Printed copy available until stock is exhausted.

At present in the United States, there are two commercial conversion facilities. These facilities process uranium concentrate into UF_6 for shipment to the enrichment facilities. One conversion facility uses a dry hydrofluor process, whereas the other facility uses a process known as the wet solvent extraction-fluorination process. Because of the different processes used in the two plants, waste characteristics, quantities, and treatment practices differ at each facility. Wastes and effluent streams contain impurities found in the concentrate (such as uranium daughters, vanadium, molybdenum, selenium, arsenic, and ammonia) and process chemicals used in the circuit (including fluorine, nitrogen, and hydrogen), as well as small quantities of uranium. Studies of suitable disposal options for the solid wastes and sludges generated at the facilities and the long-term effects of emissions to the ambient environment are needed. 30 figures, 34 tables.

7010 **(LA-UR—82-3063) Differential scanning calorimetry of metamict Pu-substituted zirconolite.** Peterson, D.E.; Clinard, F.W. Jr. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 7p. (CONF-821107—7). NTIS, PC A02/MF A01. Order Number DE83001973.

From 6. international symposium on the scientific basis for radioactive waste management; Boston, MA, USA (1 Nov 1982).

Samples of $CaPuTi_2O_7$ were prepared by cold pressing and sintering. Plutonium was substituted for zirconium in order to characterize radiation damage effects. The energy stored in a sample which had reached saturation in swelling after storage at ambient temperature was measured with a differential scanning calorimeter. The total energy of 6.6 +- 0.1 cal/g is released over the range 485 to 715°C. The activation energy of annealing of the damage is 1.22 +- 0.05 eV. The temperature dependence of the rate constant is described by k/sub T/ = 5.96E4 exp(-1.22/k/sub B/T) s^{-1} where kB and T are the Boltzmann's constant and temperature (K) respectively. A sample stored at 600°C was similarly evaluated and showed no release of stored energy to the precision of the apparatus (+- 0.1 cal/g). These results are applied to analysis of waste incorporation in SYNROC and are correlated with analogous parameters for other materials.

7011 **(LBL—14722) Database for nuclear-waste disposal for temperatures up to 300°C.** Phillips, S.L.; Silvester, L.F. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 21p. (CONF-820985—1). NTIS, PC A02/MF A01. Order Number DE83003278.

From 8. European conference on thermophysical properties - high temperatures high pressure; Baden-Baden, F.R. Germany (27 Sep 1982).

A computerized database is compiled of evaluated thermodynamic data for aqueous species associated with nuclear waste storage. The data are organized as hydrolysis and formation constants; solubilities of oxides and hydroxides; and, as Nernstian potentials. More emphasis is on stability constants. Coeffficients are given to calculate stability constants at various ionic strengths and to high temperatures. Results are presented as tables for selected species including uranium, amorphous silica and actinides.

7012 **(NUREG—0945-Vol.1) Final Environmental Impact Statement on 10 CFR Part 61 licensing requirements for land disposal of radioactive waste. Summary and main report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Nov 1982. 216p. NTIS, PC A10/MF A01 - GPO $7.50. Order Number DE83900504.

The three-volume final environmental impact statement (FEIS) is prepared to guide and support publication of a final regulation, 10 CFR Part 61, for the land disposal of low-level radioactive waste. The FEIS is prepared in response to public comments received on the draft environmental impact statement (DEIS) on the proposed Part 61 regulation. The DEIS was published in September 1981 as NUREG-0782. Public comments received on the proposed Part 61 regulation separate from the DEIS are also considered in the FEIS. The FEIS is not a rewritten version of the DEIS, which contains an exhaustive and detailed analysis of alternatives, but rather references the DEIS and presents the final decision bases and conclusions (costs and impacts) which are reflected in the Part 61 requirements. Four cases are specifically considered in the FEIS representing the following: past disposal practice, existing disposal practice, Part 61 requirements, and an upper bound example. The Summary and Main Report are contained in Volume 1. Volume 2 consists of Appendices A - Staff Analysis of Public Comments on the DEIS for 10 CFR Part 61, and Appendices B - Staff Analysis of Public Comments on Proposed 10 CFR Part 61 Rulemaking. Volume 3 contains Appendices C-F, entitled as follows: Appendix C - Revisions to Impact Analysis Methodology, Appendix D - Computer Codes Used for FEIS Calculations, Appendix E - Errata for the DEIS for 10 CFR Part 61 and last, Appendix F - Final Rule and Supplementary Information.

7013 **(ORNL/NFW—81/34) Proceedings of the Third Annual Information Meeting DOE Low-Level Waste-Management Program.** Large, D.E.; Lowrie, R.S.; Stratton, L.E.; Jacobs, D.G. (comps.). (Oak Ridge National Lab., TN (USA)). Dec 1981. Contract W-7405-ENG-26. 592p. (CONF-811130—). NTIS, PC A25/MF A01. Order Number DE82020597.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

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The Third Annual Participants Information Meeting of the Low-Level Waste Management Program was held in New Orleans, Louisiana, November 4-6, 1981 The specific purpose was to bring together appropriate representatives of industry, USNRC, program management, participating field offices, and contractors to: (1) exchange information and analyze program needs, and (2) involve participants in planning, developing and implementing technology for low-level waste management. One hundred seven registrants participated in the meeting. Presentation and workshop findings are included in these proceedings under the following headings: low-level waste activities; waste treatment; shallow land burial; remedial action; greater confinement; ORNL reports; panel workshops; and summary. Forty-six papers have been abstracted and indexed for the data base.

7014 (ORNL/NFW—81/34, pp 11-24) **Keynote: DOE's low-level waste management program.** Hamric, J.P. (Dept. of Energy, Idaho Falls, ID). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The Low-Level Waste Policy Act, which was passed in 1980, stipulates that energy state must have a solution for disposing the commercial waste generated in their states by 1986. This means that by that time, all states must do the following: conduct siting search; make a specific site study; obtain site acceptance; get industry involved; open a low-level waste disposal facility; get approval of the facility. One of the main objective of DOE's low-level waste management program is to work with the states in these areas. The keynote address focuses on this waste disposal aspect and covers the following: program status; program objectives; program strategy; status of regional compacts; program budget; and working with the states.

7015 (ORNL/NFW—81/34, pp 25-34) **Problem areas for increased emphasis.** Barainca, M.J. (Dept. of Energy, Idaho Falls, ID). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Problem areas are covered in the following four areas: overall program schedules; technical program emphasis; institutional program emphasis; and the administrative program emphasis. In the low-level waste management program there are two major systems: shallow land burial and greater confinement. Both of these areas have two subsystems: waste treatment and engineered burial. The emphasis of the paper is on technology transfer, review of the NRC regulations and validation of the program through the development of test plans, procedures, standards, etc. The need for good milestones to manage programs, and the need for a productive approach in working with the states and improving communication between the participants are pointed out.

7016 (ORNL/NFW—81/34, pp 35-38) **National activities in low-level waste.** Levin, G.B. (EG & G Idaho, Idaho Falls). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Status of regional compacts for low level waste disposal are reviewed. The first area to get a compact was the Northwestern part of the United States. The Southwestern part of the United States formed a compact under the leadership of Colorado. Under this compact, the state that generates the most waste will host the disposal site. The South Central Region states, excluding Texas, are negotiating without much success. The Midwest has completed negotiating all the principles involved in a compact and is at the point of having it written out by some lawyer. The Southeastern part has a disposal site, Barnwell in South Carolina. A compact was worked out and presented to the governors last September 24th. The Northeastern states are still in the meeting stage. Then there is one group of states left, Maryland, Delaware, West Virginia, Virginia and South Dakota. These are referred to as the SOL group. The author believes that every region should be really moving towards getting a disposal site.

7017 (ORNL/NFW—81/34, pp 39-46) **Low-level waste management program: technical program overview.** Lowrie, R.S. (Oak Ridge National Lab., TN). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The mission of the technical program is to develop the technology component of the Department of Energy's Low-Level Waste Management Program and to manage research and development, demonstration, and documentation of the technical aspects of the program. Some of the major technology objectives are: develop and demonstrate techniques for waste generation reduction; develop and demonstrate waste treatment, handling and packaging techniques; develop and demonstrate the technology for greater confinement; and develop the technology for remedial action at existing sites. In addition there is the technology transfer objective which is to compile and issue a handbook documenting the technology for each of the above technology objectives.

7018 (ORNL/NFW—81/34, pp 75-100) **EPRI's programs in low-level waste management.** Williams, R.F. (Electric Power Research Inst., Palo Alto, CA). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The programs at the Electric Power Research Institute (EPRI) are conducted in two departments. Those related to low-level waste siting technology and safety analysis are within the Systems and Materials Department. Those that relate to process technology for low-level waste disposal, equipment that would be at a power plant, are in the Engineering and Operations Department. The EPRI program objectives in waste disposal are: (1) help establish technically sound disposal regulations and licensing procedures; (2) focus R & D programs on developing essential information; (3) help implement safe disposal in a reasonable time frame; (4) provide input to needed legislation; (5) provide input to public understanding. In the area of low-level waste disposal, EPRI's objective is to provide a technology package, including the analysis of tradeoffs between waste form package and site characteristics to open a new low-level waste disposal site. To accomplish the low-level waste siting technology objective, the focus is on preparing a handbook illustrating the necessary analysis to license a new low-level waste disposal site. EPRI's accomplishments in 1982 are: retention quotient methodology for high-level waste extended to low-level waste; and development of low-level waste siting technology. Programs that are ongoing in the areas of process technology are: assessment of volume reduction technologies; assessment of incinerator performance; identification and reduction of low-level radioactive waste source; use of microwave technology in solidifying resins.

7019 (ORNL/NFW—81/34, pp 101-104) **Role of utility nuclear waste management group.** Stanford, R.E.L. (Edison Electric Inst., Washington, DC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The Utility Nuclear Waste Management Group (UNWMG) is a group of 39 nuclear utilities which support a general program which is under the administration of Edison Electric Institute (EEI), but which actually operates quite separately. The function of the group is primarily to interact with Congress in the development of desired legislation, interact with NRC and EPA in the development of regulations, and interact with DOE in the carrying out of programs in which they are interested. The group is organized into four working groups. One devotes its efforts to high-level waste activities, one to low-level waste interests, one to spent fuel storage and reprocessing, and a fourth to public information. Each of these working groups has a number of task forces that are organized to respond to a particular need at the time. The activities of each group are discussed briefly.

7020 (ORNL/NFW—81/34, pp 105-112) **Interim operations technology.** Deichman, J.L. (Rockwell Hanford Operations, Richland, WA). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Waste generation classifications at Hanford are briefly discussed. At Hanford an Environmental Impact Statement is being prepared to help define future operations for disposal. It is anticipated that criteria and standard will be issued within the time frame of 1982 through 1985 which will direct that transuranic wastes be shipped to a repository from the storage pads. The major portion of the remaining waste can then be disposed of insitu with proper barriers per criteria and standards. These insitu-techniques are yet to be defined or developed. In 1986 the DOE sites are going to be implementing the new low-level waste criteria. Significant low-

level waste technology achievements are covered briefly and areas that require study are mentioned. The need to stabilize old waste burial sites are discussed. In conclusion, the following observations are made on low-level waste disposal: (1) sites need some site-specific work; (2) standard packaging is important so that packages will not cause subsidence; (3) at time of trench closure, careful covering must be done to assure that there are no void spaces which will cause subsidence; (4) there is a need to use site-specific information that is already known to look at equivalent natural soil cover or a combined natural soil cover and barrier materials that can be laid down to prevent root or animal penetration when the burial trenches are closed; (5) work on trench design is needed; (6) engineered barriers need to be examined.

7021 (ORNL/NFW—81/34, pp 125-140) **Waste segregation.** Clark, D.E.; Colombo, P. (Brookhaven National Lab., Upton, NY). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

A scoping study has been undertaken to determine the state-of-the-art of waste segregation technology as applied to the management of low-level waste (LLW). Present-day waste segregation practices were surveyed through a review of the recent literature and by means of personal interviews with personnel at selected facilities. Among the nuclear establishments surveyed were Department of Energy (DOE) laboratories and plants, nuclear fuel cycle plants, public and private laboratories, institutions, industrial plants, and DOE and commercially operated shallow land burial sites. These survey data were used to analyze the relationship between waste segregation practices and waste treatment/disposal processes, to assess the developmental needs for improved segregation technology, and to evaluate the costs and benefits associated with the implementation of waste segregation controls. This task was planned for completion in FY 1981. It should be noted that LLW management practices are now undergoing rapid change such that the technology and requirements for waste segregation in the near future may differ significantly from those of the present day.

7022 (ORNL/NFW—81/34, pp 141-144) **Development of criteria for the shallow land burial of sodium-contaminated waste.** Abrams, C.S. (Argonne National Lab. West, Idaho Falls, ID). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

It is necessary to establish criteria for the safe shallow land burial of waste material containing small quantities of elemental sodium. The present criterion of no sodium is not realistic and probably can not be achieved. In FY81, work was begun on providing a technological base for the establishment of these criteria by conducting experiments on the safety aspects (sodium-water reactions in a closed vessel) and on the radiological aspects (tritium permeation). Additional work is required in FY82 to complete the base with additional empirical data. Using these data, criteria will be established in FY83 which will allow the safe disposal of sodium-contaminated wastes from the LMFBR program in shallow land burial.

7023 (ORNL/NFW—81/34, pp 181-190) **Interim report for the microwave plasma incinerator.** Cooper, T.D. Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Microwave Plasma Incineration is being developed to combust hard to burn and/or very toxic radioactive contaminated liquid organics. A development schedule is presented specifying significant milestone events. These milestones include the identification and optimization of the independent process variables important to the design and scale-up of the process. Assuming successful scale up of combustion rate, a potential future application of the technology is proposed which joins plasma incineration and low pressure pyrolysis to create an all-purpose incinerator. This incinerator can conceivably be operated to safely process unopened 55 gallon drums of low-level combustible waste, reducing the waste to solid blocks of metal and silicates, and combustion gases which may be released to the environment.

7024 (ORNL/NFW—81/34, pp 191-194) **Contaminated metallic melt volume reduction testing.** Deichman, J.L. (Rockwell Hanford Operations, Richland, WA). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Laboratory scale metallic melts (stainless steel) were accomplished in support of Decontamination and Decommissioning's (D & D) contaminated equipment volume reduction and Low-Level Lead Site Waste programs. Six laboratory scale melts made with contaminated stainless steel provided data that radionuclide distribution can be predicted when proper temperature rates and ranges are employed, and that major decontamination occurs with the use of designed slagging materials. Stainless steel bars were contaminated with plutonium, cobalt, cesium and europium. This study was limited to stainless steel, however, further study is desirable to establish data for other metals and alloys. This study represents a positive beginning in defining the feasibility of economical volume reduction or conversion from TRU waste forms to LLW forms for a large portion of approximately 50 thousand tons of contaminated metal waste now being stored at Hanford underground or in deactivated facilities.

7025 (ORNL/NFW—81/34, pp 195-196) **Institutional incinerator and smelter.** Thompson, J.D. (EG & G Idaho, Idaho Falls). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

This paper briefly describes the work being done under the Institutional Incinerator Program and the smelter activity at Idaho. The purpose of this demonstration is to show, by example, that medical research and treatment facilities can successfully incinerate radioactive wastes. There are two incinerators, one at Purdue University and the other at the University of Maryland. The smelter project at Idaho is actually two projects combined under the heading of Waste Experimental Reduction Facility (WERF). The WERF will contain both incinerator and smelting operations.

7026 (ORNL/NFW—81/34, pp 227-240) **Waste form development.** Neilson, R.M. Jr.; Colombo, P. (Brookhaven National Lab., Upton, NY). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

In this program, contemporary solidification agents are being investigated relative to their applications to major fuel cycle and non-fuel cycle low-level waste (LLW) streams. Work is being conducted to determine the range of conditions under which these solidification agents can be applied to specific LLW streams. These studies are directed primarily towards defining operating parameters for both improved solidification of problem wastes and solidification of new LLW streams generated from advanced volume reduction technologies. Work is being conducted to measure relevant waste form properties. These data will be compiled and evaluated to demonstrate compliance with waste form performance and shallow land burial acceptance criteria and transportation requirements (both as they exist and as they are modified with time). The work conducted under this program in FY 1981 and planned FY 1982 efforts are discussed.

7027 (ORNL/NFW—81/34, pp 241-244) **Decontamination effectiveness for metallic low level waste.** Copeland, G.L. (Oak Ridge National Lab., TN). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The effectiveness of decontamination methods for low-level metal waste is being evaluated. The major effort is gathering and evaluating information on existing and developing methods. A secondary task is assisting with the evaluation and analysis of a demonstration campaign of melt slagging for decontamination.

7028 (ORNL/NFW—81/34, pp 245-256) **Overview of low-level waste management program shallow land burial milestones and activities for milestone C.** Fitts, R.B. (Oak Ridge National Lab., TN). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

There are two shallow land burial (SLB) technology milestones in the DOE Low-Level Waste Management Program (LLWMP). These are Milestone C, Develop Technology and Documentation Required to Open a Shallow Land Burial Site (3/84) and Milestone D, Develop and Document Remedial Action Technology for SLB Sites (12/84). Milestone C is focused on the development, demonstration, and documentation of the technology needed to site, design, construct, operate, and close a safe, reliable shallow land burial facility for the disposal of low-level radioactive waste. Milestone D, on the other hand, is focused on techniques for correcting unsatisfactory performance of SLB sites as required. This review provides an overview of two aspects of Milestone C. First, the steps in the evolution of the program for SLB technology development activities are reviewed and then the current R, D & D activities are summarized.

7029 (ORNL/NFW—81/34, pp 257-260) **Radionuclide monitoring at Savannah River Plant.** Wiley, J.R. (Savannah River Lab., Aiken, SC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The humid, eastern shallow land burial site operated at Savannah River Plant for disposal of solid, low level waste is given technical support by monitoring activities at Savannah River Laboratory. These activities include drilling wells on the burial site, operating lysimeters containing well characterized waste samples, and basic laboratory study. New concepts and conclusions developed over the past year are described.

7030 (ORNL/NFW—81/34, pp 261-266) **Monitoring and physical characterization of unsaturated zone transport: radionuclide migration studies.** Jones, T.L. (Pacific Northwest Lab., Richland, WA). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

At the DOE Hanford Site in Richland, Washington, a field installation called the Buried Waste Test Facility (BWTF) has been constructed to study unsaturated soil water and contaminant transport. PNL is collecting data at the BWTF to help explain soil water movement at shallow depths, and specifically evaporation from bare soils. The soil energy balance and thermal regime is monitored by using thermocouples throughout the facility to monitor the response of soil temperature to incoming solar radiation, measured by both net radiometers and short-wave radiometers. The water balance is monitored with surface rain gauges to record precipitation and with neutron moisture gauges to follow changes in soil water content at depth. There are also two load-cell-type weighing lysimeters to provide direct measurements of average various methods for predicting water and energy balance changes that could take place in a shallow land burial ground. Calculation procedures proven acceptable may then be used to aid the design and evaluation of burial ground cover designs. This paper describes the studies on water balance and field movement of tritium.

7031 (ORNL/NFW—81/34, pp 347-352) **Trench subsidence.** Hooker, R.L. (Savannah River Lab., Aiken, SC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Settlement gages have been installed over four SRP trenches to quantify the amount & duration of settling which occurs as soil and waste compact and/or decay with time. The data will be used to quantify an observed effect and estimate the long-term maintenance requirements for burial trenches.

7032 (ORNL/NFW—81/34, pp 375-387) **Borehole-geophysics applications to low-level, radioactive-waste disposal technology.** Paillet, F.L. (Geological Survey, Denver, CO). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Borehole geophysics represents one of the most important methods for the measurement of hydrogeologic properties in situ. The US Geological Survey's research project on borehole geophysics is developing a broad spectrum of borehole techniques and data-analysis procedures for the integration of various geophysical measurements into a set of coupled equation that may be solved for hydrologic unknowns, such as porosity and hydraulic conductivity. Several areas of investigation offering opportunities for significant progress have been identified: borehole-wall imaging, acoustic determination of rock properties, gamma-spectral analysis, and flowmeter analysis. Recent progress in these areas is reviewed, and efforts planned for the immediate future are discussed. A planned assessment of the relationship between well-log resolution and ground-water model performance also is described.

7033 (ORNL/NFW—81/34, pp 397-414) **Environmental monitoring for low-level waste disposal sites.** Sedlet, J.; Golchert, N.W. (Argonne National Lab., IL). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The progress made in FY 1981 on a generic handbook (or guide) for environmental monitoring of low-level waste disposal sites is described, together with the plans for completing the work in FY 1982. A draft of the handbook was prepared which discusses the information needed to design a monitoring program, recommends programs for the preoperational, operational, and post-closure phases of a burial site, and describes sampling and measurement methods, quality assurance, and other components of a complete environmental monitoring plan. The contents of the handbook are reviewed briefly, and the sections on the use of statistics in designing a program and on applicable standards are discussed in more detail. A report on the unmet needs and technology gaps in environmental monitoring of low-level waste sites was also prepared. The currently available monitoring techniques are considered adequate. No significant needs or gaps were found, although some areas were identified in which additional work would be profitable.

7034 (ORNL/NFW—81/34, pp 415-418) **Overview of remedial action technology development milestone D.** Fitts, R.B. (Oak Ridge National Lab., TN). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

The work on remedial action technology development has the same general bases as that on improved shallow land burial technology development. The major components of work aimed at remedial action technology development involve the following general problem areas: (1) water movement; (2) subsidence; (3) erosion; (4) intrusion; and (5) radionuclide migration. Each of these components are addressed in terms of its content and ongoing research, development and demonstration work. The four principal sites active in the remedial action technology development work of the Low-Level Waste Management Program are: Oak Ridge National Laboratory (ORNL); Los Alamo National Laboratory (LANL); Rockwell Hanford Operations (RHO); and Savannah River Laboratory (SRL). The final remedial action manual is to be prepared by December of 1984. Typical important deliverables for this activity are as follows: (1) Draft State-of-the-Art Remedial Action Manual - ORNL - 6/81; (2) Draft Remedial Action Criteria - ORNL - 9/81; (3) Report on Barriers - LANL - 9/83; (4) Report on Water Management - ORNL - 9/83; (5) Reports on Subsidence Studies - LANL and ORNL - 9/84; (6) Final Remedial Action Manual - ORNL - 12/84.

7035 (ORNL/NFW—81/34, pp 447-454) **Low-level waste disposal site, subsidence and erosion control/monitoring/demonstration: a field task summary FY 1981.** Phillips, S.J. (Rockwell Hanford Operations, Richland, WA). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Rockwell Hanford Operations has conducted initial investigations relative to the development of safe, viable, and cost effective technologies to control and monitor geotechnical subsidence and erosion at low-level radioactive waste burial sites. These investigations have been completed in preparation for field testing and demonstration activities. This paper summarizes: (1) engineering evaluations of methods to control burial structure subsidence and erosion, (2) evaluation of methods and instrumentation, and (3) conceptual engineering and construction activities completed to test and verify the applicability of control methods for these sites.

7036 (ORNL/NFW—81/34, pp 455-466) **Review of remedial actions applied at shallow land burial facilities.** Jacobs, D.G.; Earnshaw, K.R.; Rose, R.R. (Evaluation Research Corp., Oak Ridge, TN). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

Evaluation Research Corporation's Oak Ridge Operations office recently completed a review of remedial actions taken to correct problems at shallow land burial (SLB) facilities operating in the US. Two staff members from Evaluation Research Corporation's Oak Ridge Operations office recently visited eleven shallow land burial facilities to observe routine operations and remedial action activities. At each of these facilities, selected problems and remedial actions were identified and documented. The main problem areas for which remedial actions are taken include water management, subsidence, wind erosion, and biological intrusion. In addition, other site management considerations are discussed in the document prepared for the DOE-Low Level Waste Management Program. These include waste packaging, space utilization, physicochemical reactions facilitating migration of radionuclides, gas phase migration, trade-offs, improved practices, and future remedial actions. The review of remedial actions taken at SLB facilities revealed that the application and evaluation of remedial actions at operating SLB facilities are not well documented. This lack of documentation may be due to two factors. First, operations personnel are primarily involved with the implementation and modification of operating procedures, whereas research-related efforts to identify problems are more likely to find their way into the literature. Second, the recent concerns with problems at SLB facilities may have resulted in recent application of remedial actions.

7037 (ORNL/NFW—81/34, pp 477-486) **Intermediate depth burial.** Hooker, R.L. (Savannah River Lab., Aiken, SC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

A second-generation Savannah River Plant (SRP) burial site is being developed for use when the current burial ground becomes filled in about 1990. Development centers around the concept of intermediate depth burial because deeper burial will retard movement of radionuclides via upwards paths - the most significant paths according to dose-to-man studies of long-term effects of burial ground operations.

7038 (ORNL/NFW—81/34, pp 489-516) **Criteria and technical concept for demonstrating greater confinement disposal of radioactive wastes at Arid Western Sites.** Hunter, P.H. (Ford, Bacon & Davis Utah Inc., Salt Lake City). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

This report summarizes the work of two documents; the Criteria for Greater Confinement of Radioactive Wastes at Arid Western Sites, NVO-234, March 1981, (within this report, referred to as the GCDF Criteria Document); and the Draft Technical Concept for a Test of Greater Confinement Disposal of Radioactive Waste in Unsaturated Media at the Nevada Test Site, FBDU-343-004, June 1981, (referred within this report as the Technical Concept for the GCDF). For the past two years, Ford, Bacon & Davis has been performing technical services for the Department of Energy at the Nevada Test Site in development of defense low-level waste management concepts, including the greater confinement disposal concept with particular application to arid sites. The investigations have included the development of Criteria for Greater Confinement Disposal, NVO-234, which we published in May of this year; then the draft for the technical concept for greater confinement disposal, published in June; leading up to the point where we are now. The final technical concept and design specifications should be published imminently. The document is prerequisite to the actual construction and implementation of the demonstration facility this fiscal year.

7039 (ORNL/NFW—81/34, pp 523-524) **Technical support non-SLB facility.** Steger, J.G. Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

To support the Greater Confinement Disposal Facility (GCDF) goal, Los Alamos proposes to perform the following subtasks: (1) data evaluation procedures for GCDF experiment; (2) instrument testing and calibration; (3) measurement system design modifications. Two field test locations will be established. The first facility will be at the Nevada Test Site (NTS) where the soil properties will be verified and instrument response will be determined using a pit about 20 feet deep. A second field facility will be constructed at Los Alamos in a caisson 10' x 20' NTS soil and backfill material will be used along with the GCDF instrument packages in the same geometry as the GCDF to duplicate as close as possible the experiment configuration planned for the GCDF. Data from these field experiments and from other Los Alamos experiments will be used to extend the validation of the two-phase, two-dimension unsaturated flow model, which has been developed by the weapons test people at Los Alamos.

7040 (OTA-O—172) **Managing commercial high-level radioactive waste: summary.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1982. 61p. Office of Technology Assessment (US Congress), Washington, DC 20510.

This summary presents the findings and conclusions of OTA's analysis of Federal policy for the management of commercial high-level radioactive waste - an issue that has been debated over the last decade and that now appears to be moving toward major congressional action. After more than 20 years of commercial nuclear power, the Federal Government has yet to develop a broadly supported policy for fulfilling its legal responsibility for the final isolation of high-level radioactive waste. OTA's study concludes that until such a policy is adopted in law, there is a substantial risk that the false starts, shifts of policy, and fluctuating support that have plagued the final isolation program in the past will continue. The continued lack of final isolation facilities has raised two key problems that underlie debates about radioactive waste policy. First, some question the continued use of nuclear power until it is shown that safe final isolation for the resulting wastes can and will be accomplished, and argue that the failure to develop final isolation facilities is evidence that it may be an insoluble problem. Second, because there are no reprocessing facilities or federal waste isolation facilities to accept spent fuel, existing reactors are running out of spent fuel storage space, and by 1986 some may face a risk of shutting down for some period. Most of the 72,000 metric tons of spent fuel expected to be generated by the year 2000 will still be in temporary storage at that time. While it is possible that utilities could provide all necessary additional storage at reactor sites before existing basins are filled, some supplemental storage may be needed if there are delays in their efforts.

7041 (PB—82-204066) **Evaluation of a predictive ground-water solute-transport model at the Idaho National Engineering Laboratory, Idaho. Water-resources investigations (final).** Lewis, B.D.; Goldstein, F.J. (Geological Survey, Idaho Falls, ID (USA). Water Resources Div.). Mar 1982. 80p. NTIS, PC A05/MF A01.

Aqueous chemical and radioactive wastes discharged to shallow ponds and to shallow or deep wells on the Idaho National Engineering Laboratory (INEL) since 1952 have affected the quality of the ground water in the underlying Snake River Plain aquifer. The aqueous wastes have created large and laterally dispersed concentration plumes within the aquifer. The waste plumes with the largest areal distribution are those of chloride, tritium, and with high specific conductance values. The data from eight wells drilled near the southern INEL boundary during the summer of 1980 were used to evaluate the accuracy of a predictive modeling study completed in 1973 that simulated 1980 positions of the chloride and tritium waste plumes.

7042 (PNL—4382, pp 182-191) **Semi-unified approach to leach testing.** Harvey, K.B. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Aug 1982. NTIS, PC A12/MF A01.

In Materials Characterization Center workshop on leaching mechanisms of nuclear waste forms, May 19-21, 1982, Gaithersburg, Maryland. Summary report.

The experimental work described suggests that the leach rates of major matrix ions of sodium borosilicates glasses under a variety of static and replenished leaching conditions are the same when expressed as a function of concentration dissolved into the leachant, and are independent of the geometry of the test. This finding is intuitively reasonable, and it may then be capable of extension to other matrices and also to minority ions diffusing from the matrix. However, since this treatment does not take into account either of changing pH or of changing temperature, it can only be termed a semi-unified approach. The results suggest that leaching numbers obtained from static tests can be applied to flowing conditions, particularly to the very low-flow conditions ($\sim 10^{-5}$% volume turnover yearly) that might be anticipated under hard-rock burial conditions, which are difficult to simulate experimentally. It follows that a static test is more economical since it gives a series of leach rate/solution concentration readings, rather than the single result obtainable from a flow test. With the use of active isotopes and counting techniques, this opens the way to completely sealed and maintenance-free leaching systems that could be monitored over a period of years. Leaching models that are appropriate to static leaching conditions are being developed. 5 figures.

7043 (PNL—4447) **Selection of a carbon-14 fixation form.** Scheele, R.D.; Burger, L.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC06-76RL01830. 60p. NTIS, PC A04/MF A01. Order Number DE83003319.

This report summarizes work on the selection of a disposal form for carbon-14 produced during the production of nuclear power. Carbon compounds were screened on the basis of solubility, thermal stability, resistance to oxidation, cost and availability, compatibility with the selected disposal matrix, leach resistance when incorporated in concrete, and compatibility with capture technologies. Carbonates are the products of the various technologies presently considered for carbon-14 capture. The alkaline earth carbonates exhibit the greatest thermal stabilities, lowest solubilities, lowest raw material cost, and greatest raw material availabilities. When reactions with cement and its impurities are considered, calcium and strontium carbonates are the only alkaline earth carbonates resistant to hydrolysis and reaction with sulfate. Leaching tests of barium, calcium, lead, potassium, and strontium carbonates in concrete showed calcium carbonate concrete to be slightly superior to the other alkaline earth carbonates, and greatly superior to a soluble carbonate, potassium carbonate, and lead carbonate. None of the additives to the concrete reduced the carbonate leaching. Acidic CO_2-containing waters were found to greatly increase carbonate leaching from concrete. Sea water was found to leach less carbon from carbonate concretes than either distilled water or Columbia River water, which showed nearly equivalent leaching. Based on our work, calcium, barium, and strontium carbonates in concrete are the most suitable waste forms for carbon-14, with calcium carbonate concrete slightly superior to the others. If the waste form is to be exposed to natural waters, sea water will have the lowest leach rate. 6 figures, 7 tables.

7044 (PNL-SA—10431) **Comparison of 200-liter and 40-milliliter leach tests.** Westsik, J.H. Jr.; Harvey, C.O.; Roberts, F.P.; Ross, W.A.; Thornhill, R.E. (Pacific Northwest Lab., Richland, WA (USA)). 1982. Contract AC06-76RL01830. 9p. (CONF-821102—27). NTIS, PC A02/MF A01. Order Number DE83002699.

From 6. international conference on powder metallurgy; Brno, Czechoslovakia (10 Nov 1982).

During the past year we have conducted a modified MCC-1 leach test on a 145 kg block of a cast cement waste form. The leach vessel was a 200 liter Teflon-lined drum and contained 97.5 liters of deionized water. The results of this large-scale leach test were compared with the results of standard MC-1 tests (40 ml) on smaller samples of the same waste form. The ratio of leachate volumes between the large and small scale tests was 2500 and the ratio of sample masses was 150,000. The cast cement samples for both tests contained plutonium-doped incinerator ash. The leachates from these tests were analyzed for both plutonium and the matrix elements. Evaluation of plutonium plateout in the large-scale test indicated that the majority of the plutonium leached from the samples deposits onto vessel walls and little ($< 3 \times 10^{-13}$/sub M/) remains in solution. Comparison of elemental concentrations in the leachates indicates some differences up to 5X in the concentration in the large- and small-scale tests. The differences are attributed to differences in the solubilities of Ca, Si, and Fe at pH 11.5 and at pH 12.5. The higher pH observed for the large-scale test is a result of the larger quantities of sodium in the large block of cement.

7045 (PNL-SA—10524) **Allowable residual contamination levels: transuranic advanced disposal systems for defense waste.** Kennedy, W.E. Jr.; Napier, B.A. (Pacific Northwest Lab., Richland, WA (USA)). 15 Jun 1982. Contract AC06-76RL01830. 6p. (CONF-821103—34). NTIS, PC A02/MF A01. Order Number DE83003459.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

An evaluation of advanced disposal systems for defense transuranic (TRU) wastes is being conducted using the Allowable Residual Contamination Level (ARCL) method. The ARCL method is based on compliance with a radiation dose rate limit through a site-specific analysis of the potential for radiation exposure to individuals. For defense TRU wastes at the Hanford Site near Richland, Washington, various advanced disposal techniques are being studied to determine their potential for application. This paper presents a discussion of the results of the first stage of the TRU advanced disposal systems project.

7046 (PNL-SA—10549) **Leach models for a commercial nuclear-waste glass.** Kuhn, W.L.; Peters, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC06-76RL01830. 9p. (CONF-821107—24). NTIS, PC A02/MF A01. Order Number DE83002698.

From 6. international symposium on the scientific basis for radioactive waste management; Boston, MA, USA (1 Nov 1982).

A review of the leaching behavior of 76-68 glass shows that it cannot be explained in terms of diffusion in the glass, which has been the basis for several leach models. Instead, we present two models based on a dissolution rate impeded by surface processes: the accumulation of a protective layer of insoluble reaction products, and adsorption of reaction products on the surface. The resulting predicted time dependences are identical and predict a change from linear to parabolic rate laws for soluble species, which is found to agree with the data over a range of temperatures. Incongruent release is attributed primarily to solubility effects. The relative merits of the models are discussed on the basis of the effect of surface area-to-volume ratio in static leach tests. Their relevance to modeling repository behaivor is discussed.

7047 **(PNL-SA—10554) Health physics monitoring practices at commercial low-level waste-disposal sites in light of 10 CFR 61 requirements.** Hadlock, D.E.; Gilchrist, R.L.; Hooker, C.D.; Herrington, W.N. (Pacific Northwest Lab., Richland, WA (USA)). 1982. Contract AC06-76RL01830. 13p. (CONF-820911—3). NTIS, PC A02/MF A01. Order Number DE83002750.

From Symposium on low level waste disposal; Washington, DC, USA (29 Sep 1982).

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The importance of maintaining occupational radiation exposures As Low as Reasonably Achievable (ALARA) is recognized and emphasized in 10 CFR 61 (Licensing Requirements for Land Disposal of Radioactive Waste) and the supporting implementing regulations. To ensure that current and future exposures are ALARA, the Nuclear Regulatory Commission contracted with the Pacific Northwest Laboratory (PNL is operated for DOE by Battelle Memorial Institute) to: (1) evaluate current health physics practices at the low-level waste (LLW) sites of Barnwell, South Carolina, Beatty, Nevada, and Hanford, Washington; (2) write a manual of good practices for LLW sites; and (3) review the findings of the site appraisals as they apply to 10 CFR 61. The site appraisals consisted of discussions with corporate and site management, discussions with technicians and operators, observation of work practices, review of current and past records and physical site tours. The evaluation of these site appraisal results and the conclusions drawn from them will be reported. The correlations of current and future ALARA practices as they relate to 10 CFR 61 will also be discussed.

7048 **(RHO-BW-SR—82-2-1Q-P) Basalt waste-isolation project drilling and testing. Quarterly report, January 1-March 31, 1982.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1 Apr 1982. Contract AC06-77RL01030. 38p. NTIS, PC A03/MF A01. Order Number DE83002810.

Rockwell Hanford Operations Drilling and Testing Group is responsible for all borehole drilling and testing conducted in support of the Basalt Waste Isolation Project. Geologic and hydrologic characterization data obtained by the group are an integral part of the studies required to assess the feasibility of using the deep basalts beneath the Hanford Site for the terminal disposal of nuclear waste. This document is a summary of drilling and testing results during the first calendar quarter (January through March) of 1982. The principal work during this period included the drilling and/or testing of boreholes RRL-2, DC-16A, DC-7/8, DC-15, DH-25, DH-26, and BH-17. 12 figures, 8 tables.

7049 **(SAND—82-1258C) Diffusion of radionuclides in brine-saturated backfill barrier materials.** Nowak, E.J. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 10p. (CONF-821107—23). NTIS, PC A02/MF A01. Order Number DE83002832.

From 6. international symposium on the scientific basis for radioactive waste management; Boston, MA, USA (1 Nov 1982).

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The diffusion of cesium (I), strontium (II), pertechnetate and europium in brine-saturated backfill materials was measured. Plastic diffusion cells containing cylindrical diffusion columns were used for low density backfill materials. The diffusion of gamma-emitters was followed by a gamma scanning technique. Metal diffusion cells constructed entirely from Hastelloy C-276 were used for the diffusion of pertechnetate in highly compacted bentonite. Apparent distribution coefficients calculated from diffusion data are (a) 0.02 m^3/kg for cesium (I) in 40 wt.% mordenite and 60 wt.% bentonite; (b) 0.04 m^3/kg for strontium (II) in 10 wt.% sodium titanate and 90 wt.% bentonite; (c) 0.5 m^3/kg for pertechnetate in 70 wt.% charcoal and 30 wt.% bentonite; and (d) 3 m^3/kg for europium in 100% bentonite. Backfill effectiveness estimates based on batch sorption measurements were supported by these results; however, the diffusion results for europium did not agree well with a model for diffusion retarded by linear sorption. First measurements of pertechnetate diffusion in highly compacted bentonite suggest that anion exclusion may play a role in reducing mass transport rates of anions in this material. Needs for diffusion measurements that take into account site-specific materials interactions are described. 8 figures, 2 tables.

7050 **(SAND—82-1594C) Surface-layer formation on a nuclear-waste glass.** Lutze, W.; Malow, G.; Rabe, H.; Headley, T.J. (Sandia National Labs., Albuquerque, NM (USA); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1982. Contract AC04-76DP00789. 9p. (CONF-821107—21). NTIS, PC A02/MF A01. Order Number DE83002516.

From 6. international symposium on the scientific basis for radioactive waste management; Boston, MA, USA (1 Nov 1982).

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Surface layers are a common feature of leached surfaces of borosilicate waste glasses. The question of whether these layers can protect the glass against further attack by decreasing the leach rate is still a subject of controversy. The present study investigates the effects of layer formation on leaching kinetics of a borosilicate waste glass containing 20 wt % LWR-type simulated waste oxides: (1) surface layer formation on the borosilicate waste glass in a closed system can be divided in a sequence of overlapping processes. The formation of amorphous phases on the glass surface is observed first, followed by crystalline phase formation, with new phases still appearing after one year in NaCl solution; (2) the complexity of the kinetics is reflected in the variation of concentration of different elements in solution; (3) the overall leaching process varies as a function of time with t/sup n/ and $n < 0.3$. This reflects that the process cannot be described in terms of either diffusion ($n = 0.5$) or linear dissolution ($n = 1$), or a combination of both; and (4) though the details of the process are not yet understood, it is possible to extract a parameter, n, to describe the total mass release from the glass in the longer term in NaCl solution if leaching data are measured for at least one year.

7051 **(SAND—82-1723) Uniaxial and triaxial compression test series on Topopah Spring tuff.** Price, R.H.; Nimick, K.G.; Zirzow, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1982. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01. Order Number DE83003837.

Fifteen uniaxial and triaxial compression experiments were performed on samples of the Topopah Spring Member of the Paintbrush Tuff obtained from drill hole USW-G1 at Yucca Mountain on the Nevada Test Site. The water saturated test specimens were deformed at nominal strain rates of 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6} s^{-1}; confining pressures of 0.1, 5 and 10 MPa; and room temperature. Resultant unconfined compressive strengths, axial strains to failure, Young's moduli and Poisson's ratios ranged from 44.9 to 176.6 MPa, .0034 to .0057, 22.9 to 40.8 GPa and .15 to .33, respectively.

7052 **(STUDSVIK-NW—81/149) Evaluation of ISO long-term leach data for concrete using least-squares refinements of parameters in a simple empirical model.** Sjoeblom, R. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 8 Dec 1981. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702903.

See also STUDSVIK-NW--81/68.

Leach data reported previously for cesium in concrete at room temperature have been used in least-squares refinements of the parameters a, b and c in the empirical model Q = a(tsup(b)-c) where Q is the total amount leached after time t. Systematic differences between the experimental and the calculated values were observed for the data obtained during the first few days. This contributed somewhat to the root mean square difference between the observed and calculated values which was finally about 25%. The values obtained for the parameters deviate substantially from those expected for a simple linear diffusion model. No interpretations are made as to the nature of the relevant mechanisms, but it can be concluded that the computer program and procedure used are suitable for such model studies.

7053 **(UCID—19598) SYNROC powder preparation: preliminary fluid bed tests in a cold-flow unit.** Peters, P.E.; Ackerman, F.J.; Grens, J.Z. (Lawrence Livermore National Lab., CA (USA)). 28 Oct 1982. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01. Order Number DE83003150.

SYNROC is a titanate-based material which is being developed as a medium for immobilizing high-level nuclear waste. The use of a fluid bed unit for production of SYNROC powder has a precedent in the use of a fluid-bed calciner for high-level waste

processing at the Idaho Chemical Processing Plant (Idaho Falls, ID). In order to facilitate the design of a fluid bed and demonstrate its use for SYNROC production, two small units have been constructed, one for low temperature use and a second for actual SYNROC production at temperatures up to 800°C. The low-temperature unit is constructed with glass walls to allow observation of the fluidization process, including the onset of fluidization, bed and gas bubble behavior and mixing phenomena. Disturbances caused by side streams entering the bed have been examined. Side streams may represent fuel and oxidizer admission or slurry feed with subsequent flash vaporization of the carrier liquid. This report is a summary of the initial tests made with the low-temperature, glass-walled fluid bed. The tests described include: (1) the measurement of basic fluidization parameters; (2) measurement of the effect of distribution-plate design on bed fluidization; (3) observation of jet penetration, bubble formation and coalescence, and surface behavior; and (4) studies of mixing within the bed. (DMC)

7054 **(UCID—19606) Design and testing of Spec 7A containers for packaging radioactive wastes.** Roberts, R.S.; Perkins, C.L. (Lawrence Livermore National Lab., CA (USA)). 19 Nov 1982. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE83003055.

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For a variety of reasons, the containers that have or currently are being used for packaging radioactive waste have drawbacks which has motivated LLNL to investigate, design and destructively test different Type A containers. The result of this work is manifested in the TX-4, which is comparatively lightweight, increases the net payload, and the simplicity of the design and ease in handling have proved to be timesaving. The TX-4 is readily available, relatively inexpensive and practical to use. It easily meets Type A packaging specifications with a gross payload of 7000 pounds. Although no tests were performed at a higher weight, we feel that the TX-4 could pass the tests at higher gross weights if the need arises. 20 figures.

7055 **(NUREG—0945-Vol.2-App.A-B) Final Environmental Impact Statement on 10 CFR Part 61 licensing requirements for land disposal of radioactive waste.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Nov 1982. 631p. NTIS, PC A99/MF A01 - GPO $13.00. Order Number DE83900505.

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The three-volume final environmental impact statement (FEIS) is prepared to guide and support publication of a final regulation, 10 CFR Part 61, for the land disposal of low-level radioactive waste. The FEIS is prepared in response to public comments received on the draft environmental impact statement (DEIS) on the proposed Part 61 regulation. The DEIS was published in September 1981 as NUREG-0782. Public comments received on the proposed Part 61 regulation separate from the DEIS are also considered in the FEIS. The FEIS is not a rewritten version of the DEIS, which contains an exhaustive and detailed analysis of alternatives, but rather references the DEIS and presents the final decision bases and conclusions (costs and impacts) which are reflected in the Part 61 requirements. Four cases are specifically considered in the FEIS representing the following: past disposal practice, existing disposal practice, Part 61 requirements, and an upper bound example. The Summary and Main Report are contained in Volume 1. Volume 2 consists of Appendices A - Staff Analysis of Public Comments on the DEIS for 10 CFR Part 61, and Appendices B - Staff Analysis of Public Comments on Proposed 10 CFR Part 61 Rulemaking. Volume 3 contains Appendices C-F, entitled as follows: Appendix C - Revisions to Impact Analysis Methodology, Appendix D - Computer Codes Used for FEIS Calculations, Appendix E - Errata for the DEIS for 10 CFR Part 61 and last, Appendix F - Final Rule and Supplementary Information.

7056 **(NUREG—0945-Vol.3-App.C-F) Final Environmental Impact Statement on 10 CFR Part 61 licensing requirements for land disposal of radioactive waste.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Nov 1982. 432p. NTIS, PC A19/MF A01 - GPO $11.00. Order Number DE83900506.

The three-volume final environmental impact statement (FEIS) is prepared to guide and support publication of a final regulation, 10 CFR Part 61, for the land disposal of low-level radioactive waste. The FEIS is prepared in response to public comments received on the draft environmental impact statement (DEIS) on the proposed Part 61 regulation. The DEIS was published in September 1981 as NUREG-0782. Public comments received on the proposed Part 61 regulation separate from the DEIS are also considered in the FEIS. The FEIS is not a rewritten version of the DEIS, which contains an exhaustive and detailed analysis of alternatives, but rather references the DEIS and presents the final decision bases and conclusions (costs and impacts) which are reflected in the Part 61 requirements. Four cases are specifically considered in the FEIS representing the following: past disposal practice, existing disposal practice, Part 61 requirements, and an upper bound example. The Summary and Main Report are contained in Volume 1. Volume 2 consists of Appendices A - Staff Analysis of Public Comments on the DEIS for 10 CFR Part 61, and Appendices B - Staff Analysis of Public Comments on Proposed 10 CFR Part 61 Rulemaking. Volume 3 contains Appendices C-F, entitled as follows: Appendix C - Revisions to Impact Analysis Methodology, Appendix D - Computer Codes Used for FEIS Calculations, Appendix E - Errata for the DEIS for 10 CFR Part 61 and last, Appendix F - Final Rule and Supplementary Information.

7057 **Method for forming microspheres for encapsulation of nuclear waste.** Angelini, P.; Caputo, A.J.; Hutchens, R.E.; Lackey, W.J.; Stinton, D.P. (to Dept. of Energy). US Patent Application 343,803. 29 Jan 1982. 14p. Contract W-7405-ENG-26.

Microspheres for nuclear waste storage are formed by gelling droplets containing the waste in a gelation fluid, transferring the gelled droplets to a furnace without the washing step previously used, and heating the unwashed gelled droplets in the furnace under temperature or humidity conditions that result in a substantially linear rate of removal of volatile components therefrom. Fuel particles were also produced using this method.

7058 **National program for isolating high-level nuclear waste.** Smedes, H. *Underground Space;* 6: No. 4-5, 220-228(Jan 1982).

From Underground space conference and exposition; Kansas City, MO, USA (10 Jun 1981).

For some time, the US program for managing high-level radioactive waste has focused on the method of deep geologic isolation. The national objectives for waste isolation in this manner are summarized herein, and the status and outlook of the program designed to carry out the objectives are described. Attention is given to the goals and plans of the US Department of Energy, the department's work is described, and key issues in siting a geologic repository for high-level waste are pinpointed.

7059 **Solidification of high-level waste.** Harrington, R.V. (Ferro Corp., Independence, OH); Apps, J.A. *Underground Space;* 6: No. 4-5, 259-263(Jan 1982).

Various solid waste forms suitable for solidification of high-level radioactive waste were reviewed, and the properties of these are tabulated. Solid forms considered were glass, glass-ceramic, calcine, super-calcine, ceramic analogues to minerals, and cement. Borosilicate glass, which has been widely studied, appears to be highly satisfactory, but some of the other types of materials hold promise as fixatants. The choice of final form may be dictated on the basis of economics, processing safety, or repository interaction rather than just on the basis of leachability. (BLM)

7060 **Monitoring an underground repository with modern seismological methods.** Majer, E.L.; McEvilly, T.V.; King, M.S. (Lawrence Berkeley Lab., CA). *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts;* **18**: No. 6, 517-527(Dec 1981). Contract W-7405-ENG-48.

An experiment utilizing microearthquake and acoustic emission techniques has been designed to investigate the discrete failure and behavior of hard rock in response to storage of high level nuclear waste. Data are presently being collected from a 15-station, three-dimensional array of piezoelectric sensors surrounding 11 canisters of spent nuclear fuel and 6 electrically heated simulator canisters. The canisters are arranged in a linear array 420 m beneath the surface in the Climax Stock at the Nevada Test Site. Because of the unique scale of the experiment (array dimension - 50 x 20 x 10 m), techniques employed are drawn from the fields of acoustic emission and earthquake analysis. The data are digitized and analyzed in-field via an Automated Seismic Processor (ASP) developed for earthquake studies. Although the discrete events are high frequency in nature (1-10 kHz) their behavior and appearance are typical of shear failure observed in microearthquake sequences. Sought are not only the spatial and temporal characteristics of the events with respect to induced thermal, mechanical, or radiation stresses, but also a complete understanding of the source characteristics relative to these induced stresses. The velocity and attenuation characteristics within the array imply that the rock is not homogenous at the observed frequencies. This paper reviews the basis for the experiment's concept, the instrumentation emplaced, and preliminary results of the monitoring program.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 7009, 7012, 7029, 7030, 7031, 7033, 7034, 7035, 7036, 7042, 7044, 7046, 7052, 7055

7061 (ORNL/NFW—81/34, pp 277-282) **Microbial effects on radioactive wastes at SLB sites.** Weiss, A.J.; Colombo, P. (Brookhaven National Lab., Upton, NY). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

A significant fraction of DOE and commercially generated low-level radioactive waste consists of organic materials. These materials are subject to degradation by microorganisms present in the shallow land burial environment and may contribute to enhanced migration of radionuclides through the formation of gases, mobile complexes and bioaccumulation. This scanning study will determine the effects of microbial degradation at present disposal sites and their impact on shallow land burial performance criteria, trench construction and segregation of organic wastes. The main objective of this program is to determine the significant effects of microbial activities on shallow land burial (SLB). The program is in support of DOE/LLW Management Program alpha milestones B, C, and D.

7062 (ORNL/NFW—81/34, pp 283-298) **Monitoring and physical characterization of unsaturated zone transport: model documentation and application.** Jones, T.L. (Pacific Northwest Lab., Richland, WA). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

A major part of the zone transport project has been to evaluate the applicability of existing water and solute transport models. The water transport work has evaluated the common parameter estimation techniques, particularly hydraulic conductivity, and is currently concentrating on evaluating evaporation models. The solute transport work has been evaluating the applicability of two solute models to a variety of radionuclides and transport conditions. The models examined are the two parameter convective-dispersive equation and the four parameter mobile-immobile water equation of van Genuchten and Wierenga. The movement of tritium and strontium-85 was evaluated using standard column methods and the movement of strontium-85 was also investigated under changing levels of soil salinity.

7063 (ORNL/NFW—81/34, pp 305-306) **Savannah River Laboratory dose to man model.** Wiley, J.R. (Savannah River Lab., Aiken, SC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

A radionuclide transport model designed to provide guidance for present SRP burial ground operation and decommissioning, and for design of an improved future site will be described. Results of modeling ^{137}Cs, ^{90}Sr, and Pu transport will be presented. Vegetative uptake studies to improve critical-path data will also be described.

0540 Health And Safety

REFER ALSO TO CITATION(S) 6999, 7034, 7047, 8428

7064 **(PB—82-210204) Methods of low-level counting and spectrometry. Final report.** Mann, W.B.; Hutchinson, J.M.R.; Edgerly, D.E. (National Bureau of Standards, Washington, DC (USA)). 1981. 15p. Pub. in Proceedings of Symposium on 'Methods of Low-Level Counting and Spectrometry', Berlin, West Germany, June 10, 1981, p173-187 1981.

The quality of radioactivity measurements in this period of rapidly expanding production and use of radioactive materials and their transfer to the biosphere has come under increasing scrutiny from government regulatory agencies and the public alike. This paper reviews the history and present status of measurements assurance, or traceability, programmes developed in the USA to ensure the quality of such measurements. It also briefly describes intercomparative measurements carried out with other national laboratories either directly or through the BIPM and the IAEA for the purpose of establishing traceability in the international field. It is concluded that in the USA it is logistically impossible, except in a few special cases, for the NBS to provide other than programmes that will give implicit quality assurance for radioactivity measurements.

7065 **Evolution of safety philosophy for the ICPP eletrolytic dissolver process.** Fergus, I.E.; Johnson, J.E. (Exxon Nuclear Idaho Co., Inc., P.O. Box 2800, Idaho Falls, ID 83401). *Transactions of the American Nuclear Society;* **41**: 345(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

7066 **Nuclear criticality safety practices in digestion systems of the large-scale production facility of the DOE at Fernald.** Capano-Dolan, L. (National Lead Company of Ohio, P.O. Box 39158, Cincinnati, OH 45239). *Transactions of the American Nuclear Society;* **41**: 347-350(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

0550 Regulations

REFER ALSO TO CITATION(S) 6994, 6997, 7016, 8108

7067 **(BNL—31978) Neutron techniques in Safeguards.** Zucker, M.S. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 6p. (CONF-820950—5). NTIS, PC A02/MF A01. Order Number DE83002216.

From Conference on the neutron and its applications; Cambridge, UK (13 Sep 1982).

Portions of document are illegible.

An essential part of Safeguards is the ability to quantitatively and nondestructively assay those materials with special neutron-interactive properties involved in nuclear industrial or military technology. Neutron techniques have furnished most of the important ways of assaying such materials, which is no surprise since the neutronic properties are what characterizes them. The techniques em-

ployed rely on a wide selection of the many methods of neutron generation, detection, and data analysis that have been developed for neutron physics and nuclear science in general.

7068 **(EPRI-NP—2631) Safeguarded fabrication and reprocessing (SAFAR).** Campbell, M.H.; Tomlinson, R.E. (Exxon Nuclear Co., Inc., Richland, WA (USA)). Nov 1982. 122p. NTIS, PC A06/MF A01. Order Number DE83900736.

This report describes a design concept for meeting most NRC and IAEA safeguards goals while reprocessing irradiated fuels and fabricating plutonium-bearing fuels in a commercially viable facility. The SAFAR (Safeguarded Fabrication and Reprocessing) concept includes a modified Purex flowsheet for fuel reprocessing and a Sphere Pac process for fuel fabrication in an integrated facility. The Purex process is modified so that plutonium moves through the system in essentially plug flow, permitting a plutonium inventory to be made with only a few hours lost production. In the Sphere Pac process, sized $(U,Pu)O_2$ spheres are made remotely with a continuous gelation process. The calcined and sintered spheres are then loaded remotely into the fuel rods. Significant safeguards features include (1) a practical way to inventory plutonium every 15 days, (2) a LEMUF (limit of error in material unaccounted for) of 0.7 percent over a 15-day period or 0.35 percent over a six-month period, (3) isolation of plutonium behind massive shielding walls when not sealed within massive containers for transport, and (4) assumed control of the movement of people under both routine and abnormal conditions. One NRC goal would not be met. Reducing the plutonium LEMUF to 2 kilograms over a one-year period would require measurement accuracies more than an order of magnitude better than that attained by the National Bureau of Standards when preparing plutonium standards. All other identified NRC and IAEA goals were met. It is estimated that the features provided for improved safeguards would increase unit cost no more than ten percent.

7069 **(EPRI-NP—2632) Diversion-resistance assessment bases. Interim report.** Campbell, M.H.; Jaech, J.L.; Hansen, L.E.; Nilson, R.; Schneider, R.A.; Tomlinson, R.E. (Exxon Nuclear Co., Inc., Richland, WA (USA)). Nov 1982. 122p. NTIS, PC A06/MF A01. Order Number DE83900642.

This document describes a logical approach to diversion resistance assessment methodology. A combination of objective attribute assessments and subjective evaluations based upon a composite expert opinion is advocated. The objective approach shows where to look and the subjective approach provides an integrated assessment. For the objective attribute valuation, three attributes were considered: the plutonium density; the gamma energy attribute of plutonium as a function of purification and concentration; and the difficulty of converting the diverted material into a bomb. The product of these three objective measures is called the attribute factor. A subjective evaluation was achieved using the expert group Delphi process. This process takes note of the attribute factor and goes further by considering the interacting values of the process, operating procedures, scheduling and safeguards-physical security plans. As a base case, the Delphi was applied to the NFRRC reprocessing plant designed by ENC. With the in-depth knowledge the expert group had on this particular facility, anomalies arising from the Delphi evaluation could be readily evaluated. The methodology utilizing an expert group Delphi evaluation provides a subjective evaluation that balances design features, process attributes and operational control to yield a cumulate measure of the diversion resistance for a facility.

7070 **(HEDL-SA—2785-FP) On-line computing in a classified environment.** O'Callaghan, P.B. (Hanford Engineering Development Lab., Richland, WA (USA)). 25 Oct 1982. Contract AC06-76FF02170. 12p. (CONF-821126—2). NTIS, PC A02/MF A01. Order Number DE83002239.

From 5. DOE computer security conference; Knoxville, TN, USA (16 Nov 1982).

Westinghouse Hanford Company (WHC) recently developed a Department of Energy (DOE) approved real-time, on-line computer system to control nuclear material. The system simultaneously processes both classified and unclassified information. Implementation of this system required application of many security techniques. The system has a secure, but user friendly interface. Many software applications protect the integrity of the data base from malevolent or accidental errors. Programming practices ensure the integrity of the computer system software. The audit trail and the reports generation capability record user actions and status of the nuclear material inventory.

7071 **(KFK—3264) Investigation on the application of the isotopic correlation technique in post-irradiation analysis and safeguards.** Marzo, M.A.S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Jan 1982. 177p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750661.

An extensive analysis of irradiated fuel shows that the theoretical prediction of isotopic ratios for actinides in PWRs is very satisfactory. Comparisons of theoretical results with those from post-irradiation measurements demonstrate the capability of the used data and methods: all calculated values are within the range of the interlaboratory deviations. Sensitivities for a variety of isotopic ratios on reactor parameters as burn-up, enrichment, boron concentration, fuel-to-moderator-ratio, etc. have been calculated. On the basis of these sensitivity studies, a recipe has been worked out how to apply the isotopic correlation techniques to safeguarding fissile material. The capability of this recipe is demonstrated for realistic situations. The essential characteristic of the proposed method lies in the application of several (e.g. six) selectively sensitive (with respect to the reactor parameters) isotopic correlations. Theory is used as a verified tool in deciding on erroneous measurements, accidental or intentional fuel substitution or diversion. The proposed recipe is verified with simulated as well as with realistic, actually observed examples.

7072 **(LA—9373-PR) Safeguards and security status report, August 1981-January 1982.** Shipley, J.P. (comp.). (Los Alamos National Lab., NM (USA)). Sep 1982. Contract W-7405-ENG-36. 70p. NTIS, PC A04/MF A01. Order Number DE83002917.

Portions of document are illegible. Printed copy available until stock is exhausted.

From August 1981 through January 1982, the Los Alamos Safeguards and Security Program was involved in many activities that are described in the four parts of this report: Nuclear Facility Safeguards Support, Security Development and Support, Safeguards Technology Development, and International Support. Part 1 covers those efforts of direct assistance to the Department of Energy and the Nuclear Regulatory Commission licensee facilities. This assistance varies from consultation on materials accounting problems, through development of specialized techniques and devices, to comprehensive participation in the design and implementation of advanced safeguards systems. In addition, a series of training courses in various aspects of safeguards helps make the technology more accessible to those who must apply it. Part 2 concerns a relatively new set of activities at Los Alamos aimed at the security of information and computer systems. The focus this period has been on furthering the development of the Computer Security Center, which provides the basis for encouraging and disseminating the emerging technology. Part 3 describes the development efforts that are essential to continued improvements in the practice of safeguards. Although these projects are properly classified as developmental, in every case they are directed ultimately at recognized problems that commonly occur in operating facilities. Finally, Part 4 covers international safeguards activities, including both support to the International Atomic Energy Agency and bilateral exchanges. In addition, enrichment plant safeguards, especially those concerning the Gaseous Centrifuge Enrichment Plant, required a significant portion of our resources. These efforts are beginning to provide substantial returns on our investment in technology transfer.

7073 (ORNL/NFW—81/34, pp 47-56) **NRC activities related to 10 CFR Part 61.** Smith, R.D. (Nuclear Regulatory Commission, Washington, DC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

This paper presents a brief historical development of 10 CFR Part 61, which is a federal regulation to govern the licensing of low-level waste disposal site in Nonagreement States, and discusses in detail three aspects to it: procedural aspect; technical aspects; and miscellaneous requirements of which financial assurance requirements are the most important. The procedural aspects cover five phases in the licensing of a low-level waste disposal site: preoperational, operational, site closure, post closure, and institutional control. In laying out the technical part of 10 CFR Part 61, performance objectives were set in four areas, three of which are related to protection of people from the effects of radiation, and the fourth with the long term institutional care of the site.

7074 (ORNL/NFW—81/34, pp 57-74) **Overview of NRC's low-level waste activities.** Stewart, J.C. (Nuclear Regulatory Commission, Washington, DC). Dec 1981. NTIS, PC A25/MF A01.

From 3. annual DOE participants information meeting on low-level waste management; New Orleans, LA, USA (4 Nov 1981).

This presentation describes the major objectives of the NRC Low-Level Waste Program today, gives an overview of the major accomplishments for FY 81 and what the major goals are for FY 82. Also included is a brief discussion of the contractual support. This presentation also provides dollars and the type of projects the NRC is doing but does not go into any detail.

7075 (PNL-SA—10514) **Combining item and bulk material loss-detection uncertainties.** Eggers, R.F. (Pacific Northwest Lab., Richland, WA (USA)). 1982. Contract AC06-76RL01830. 3p. (CONF-820713—28). NTIS, PC A03/MF A01. Order Number DE83003472.

From Institute of Nuclear Materials meeting; Washington, DC, USA (19 Jul 1982).

Loss detection requirements, such as five formula kilograms with 99% probability of detection, which apply to the sum of losses from material in both item and bulk form, constitute a special problem for the nuclear material statistician. Requirements of this type are included in the Material Control and Accounting Reform Amendments described in the Advance Notice of Proposed Rule Making (Federal Register, 46(175):45144-46151). Attribute test sampling of items is the method used to detect gross defects in the inventory of items in a given control unit. Attribute sampling plans are designed to detect a loss of a specificed goal quantity of material with a given probability. In contrast to the methods and statistical models used for item loss detection, bulk material loss detection requires all the material entering and leaving a control unit to be measured and the calculation of a loss estimator that will be tested against an appropriate alarm threshold. The alarm threshold is determined from an estimate of the error inherent in the components of the loss estimator. In this paper a simple grahical method of evaluating the combined capabilities of bulk material loss detection methods and item attribute testing procedures will be described. Quantitative results will be given for several cases, indicating how a decrease in the precision of the item loss detection method tends to force an increase in the precision of the bulk loss detection procedure in order to meet the overall detection requirement. 4 figures.

06 FUSION FUELS

0601 Sources

7076 **Hydrogen isotope separation.** Bartlit, J.R.; Denton, W.H.; Sherman, R.H. (to Department Of Energy). US Patent 4,353,871. 12 Oct 1982. Filed date 10 May 1979. vp.

PAT-APPL-037603.

A system of four cryogenic fractional distillation columns interlinked with two equilibrators for separating a DT and hydrogen feed stream into four product streams, consists of a stream of high purity D2, DT, T2, and a tritium-free stream of HD for waste disposal.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

7077 (CONF-821123—8) **Availability of enriched isotopic material for accelerator targets.** Newman, E. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE83003445.

From 7. conference on the application of accelerators in research and industry; Denton, TX, USA (8 Nov 1982).

The electromagnetic isotope enrichment facility at ORNL provides a broad spectrum of highly enriched stable isotopes to the worldwide scientific community. The continued timely availability of these materials is of vital importance in many areas of basic research and, in particular, as source material for the fabrication of accelerator targets. A brief description of the facility and its capabilities and limitations is presented.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 7853, 7878

7078 (KFK-AFR—003, pp 13) **Activation process for wear measurements in mechanical engineering.** Fehsenfeld, P. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

7079 (KFK-AFR—003, pp 15) **Role of radionuclide wear measurements in roller bearings.** Meier, H.; Albrecht, W.; Geheeb, N.; Hecker, W.; Zeitler, G.; Unger, E. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 7115, 8098

7080 (BNL—51578) **Development of static feed water electrolysis for large scale hydrogen production. Final report.** Burke, K.A.; Schubert, F.H. (Life Systems, Inc., Cleveland, OH (USA)). Jul 1982. Contract AC02-76CH00016. 52p. NTIS, PC A04/MF A01. Order Number DE83003827.

The following conclusions are direct results of the program activities: high current density testing with the static feed approach to water electrolysis has demonstrated that there are no mass transport limitations in the static feed cell up to 1000 ASF; Life Systems' advanced electrode and super electrode are capable of operating at high current densities (up to 1000 ASF). Both types of electrodes exhibit voltage efficiency performance exceeding that of conventionally used water electrolysis electrodes, and have the potential to generate low cost hydrogen; the static feed water electrolysis cell is capable of operating from low quality water sources without electrochemical performance deterioration; because of the elimination of the bulk KOH electrolyte from the feed water compartment, it appears feasible that the static feed cell design can be simplified from a four compartment cell to a three compartment cell where the coolant and water feed functions are combined in one compartment; the static feed cell is capable of being scaled-up to active cell areas of 1.0 ft^2. The performance of the 1.0 ft^2 cell is comparable to the performance observed in Life Systems' 0.1 ft^2 single cell with the same electrode configuration; and the static feed electrolysis system is simpler in overall system design than comparable conventional systems. This advantage combined with

Life Systems' superior performance electrodes make this technology attractive for further development and eventual application into large scale hydrogen generation systems.

7081 **(PB—82-220591) Hydrogen production from thermal decomposition of water (by solar radiation). Annual report 1 Sep 80-31 Sep 81.** Jellinek, H.H.G.; Kitamura, Y.; Kachi, H.; Juznic, K. (Clarkson Coll. of Tech., Potsdam, NY (USA). Dept. of Chemistry). Oct 1981. 32p. NTIS, PC A03/MF A01.

The high temperature apparatus has been modified to its final form and works satisfactorily. Steam protective coatings for refractory metals (e.g. Mo) have been prepared. However, none lasted long enough although they were superior to any found in the literature. Thus the original approach was not feasible for the following reasons: (1) the technology of protective coatings is not yet advanced enough; (2) it is doubtful whether coated membranes are sufficiently permeable for H2, (3) the pressure gradient of H2 across the membrane will be very small even at 2500C and exceedingly large membranes will have to be heated. The results forced us to look for new approaches. Two were tested by successful preliminary experiments: (1) the thermal gradient approach and (2) the Two-Step Approach where production and permeation of H2 are completely separated. This second approach is a complete breakthrough in the area of H2-production from thermal decomposition of water and will be the subject-matter of a continuation proposal being submitted.

7082 **Hydrogen production and storage.** Pottier, M. (Gaz de France, Paris). pp 115-144 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Industrialized countries for their energy consumption have been supplied in the past by fossil fuels and progressively turn to nuclear energy. Thermal energy is an intermediate between primary source and final useful carrier. Out of these electricity is the easiest to use but not suited to storage. In order to economically operate production and transmission systems, in front of customers variable needs, energy storage is necessary. Energy storage can be achieved through chemical means by hydrogen. This gaseous energy carrier could be produced from water through thermochemical cycles or electrolysis and is well suited to massive storage and transportation.

7083 (EUR—7042-Pt.-1-Pt.-2-DE, pp 1-123) **Thermochemical production of hydrogen, separation method. Pt. 1.** Hartmann, H. 1981. (In German). Amt fuer amtliche Veroeffentlichungen der Europaeischen Gemeinschaften, Luxembourg.

In Thermochemical production of hydrogen, separation method.

A measuring method is described in the present work to measure vapour pressure and phase equilibria of strongly corrosive materials up to 28 bar and 500°C. Extensive vapour pressure measurements were performed for the system $H_2O + H_2SO_4$ in a broad concentration range of the liquid. The azeotropic point of the system was determined and presented in analytic form. Supplementary vapour-liquid phase equilibria measurements show good agreement with literature data. The necessity of additional phase equilibria measurements to select the formulation for the free excess enthalpy is shown by the example of the preliminary calculation of the vapour-liquid phase equilibrium from vapour pressure measurements.

7084 (EUR—7042-Pt.-1-Pt.-2-DE, pp 1-26) **Thermochemical production of hydrogen, separation method. Pt. 2.** Hartmann, H. 1981. (In German). Amt fuer amtliche Veroeffentlichungen der Europaeischen Gemeinschaften, Luxembourg.

In Thermochemical production of hydrogen, separation method.

For the design of technical absorption columns mass transfer coefficients, interfacial areas and solubilities must be known. In this report first measurements of the kinetics of the absorption of SO_2 and O_2 in water are given. The measurements were done by the stirring cell method after Danckwerts. The system pressure was 30 bars max., temperature 25°C and 40°C, the mass fraction of SO_2 in the mixture 20 weight-percent.

0802 Storage

REFER ALSO TO CITATION(S) 7246, 7919

7085 **(EUR—7314-DE) Stationary hydride storage systems for the storage of electric peak power.** Buchner, H.; Schmidt-Ihn, E.; Kliem, E.; Lang, U.; Scheer, U. (Commission of the European Communities, Luxembourg). 1981. vp. (In German). Amt fuer amtliche Veroeffentlichungen der Europaeischen Gemeinschaften, Luxembourg.

The storage of electric peak energy by means of hydrogen has been investigated for a stationary hydride storage system with a capacity of 100-1,000 MWh (32,000-320,000 m^3 of H_2) under technical and economic aspects. TiCr, Mn-based low-temperature hydrides developed at Daimler-Benz which store 2% of hydrogen were chosen for the construction of the stationary hydrogen storage and their thermodynamic and kinetic properties as well as their thermal conductivity as a basic factor for the technological computation were examined. The low thermal conductivity of the material is considerably improved by the admixture of metal powder - a method devloped by Daimler-Benz. An operation cycle comprising 8 hours each of absorption, storage and desorption was assumed. In this case heat flow is the rate limiting factor. The H_2-storage pressure is 10 or 55 bars. Two variants (steel or concrete outer jacket) are designed and described. Depending on its size the hydride storage system consists of 2 or 20 storage units with a H_2-capacity of 16 000 m^3 each. Several alternatives for the selection of a suitable location for the hydride storage system are mentioned and discussed and the investment and operating costs for 4 hydride storage systems are quoted. A comparison with the costs of other forms of hydrogen storage show that the hydrogen storage with hydrides is more economical than the storage of liquid hydrogen and pressurized gas.

7086 **(SITRA-A—67) Metal hydrides for storing hydrogen and energy. 1. Hydrogen economy. 2. Properties and production of rechargeable hydrides.** Jaakkola, S. (Suomen Itsenaeisyyden Juhlavuoden 1067 Rahasto (SITRA), Helsinki (Finland)). 1981. 89p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82751038.

The most promising possibilities to produce hydrogen on a large scale are considered to be the thermochemical splitting of water and a significant improvement in the efficiency of water electrolysis by using solid electrolytes. Photolytic production of hydrogen by solar radiation is still at the stage of laboratory experiments and the conversion efficiencies attained so far are not too encouraging. In addition to the small density of hydrogen the difficulties involved in its safe and convenient storage have, for their part, prevented the widespread use of hydrogen as a synthetic energy carrier and fuel. The energy requirement for liquefaction still represents at least 30% of hydrogen's heat of combustion (121 MJ/kg) and there are always evaporation losses of this cryogenic liquid. The primary reason why interstitial hydrides of metals have been proposed as hydrogen or energy storage media is the high volumetric density of hydrogen in these compounds. Another basic and applicable property of metal hydrides is the heat of formation H which is released when the metal absorbs hydrogen. Apart from the stability and hydrogen storage capacity, other factors which should be well considered when choosing metal hydride for a given application are the kinetics of absorption and desorption, the ease of initial activation and reactivation, the poisoning effects of impurities in the hydrogen gas and metal and the fragmentation of the hydride grains in repeated absorption-desorption cycles. The electron-deficient compounds O_2, H_2O, SO_2, H_2S, CO and Cl_2 are, among others, detrimental gaseous poisons capable of impeding the dissociative chemisorption on metal surfaces. The simplest techniques for a large scale production of intermetallic hydride formers is to melt the component metals together in an arc or induction furnace.

7087 **Metal hydrides for heat storage of combustion and reaction processes.** Bernauer, O.; Buchner, H. pp 351-386 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Metal hydrides are heat storage means with high storage densities. By variation of the hydrides it is possible to store and

regain waste heat on nearly all temperature levels. Therefore, such systems would be suitable for a large number of combustion and chemical reaction processes. Different applications of hydrides in closed systems (where hydrogen is not consumed) and in open systems (where hydrogen is consumed) are discussed.

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 7834

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 6725, 6739, 6741, 7122, 7249, 7857, 7860, 7892, 8090

7088 **(DOE/PC/41264—T1) Upgrading of Fischer-Tropsch liquids over ZSM-5 using model compounds. Final report, April 1, 1981-July 15, 1982.** Anthony, R.G. (Texas A and M Univ., College Station (USA)). May 1982. Contract AC22-81PC41264. 153p. NTIS, PC A08/MF A01. Order Number DE82017456.

Portions of document are illegible. Printed copy available until stock is exhausted.

The objective of this research was to gather catalytic and kinetic data on model compounds and Fischer-Tropsch liquid. These data were to be used to categorize the possible behavior exhibited by compounds similar in scope to Fischer-Tropsch liquids. Two separate metal-exchanged ZSM-5 catalysts were used, along with the hydrogen form. Catalytic testing results showed a wide range of product distributions with n-decanal producing the highest liquid and aromatic yield. The n-heptane produced the lowest of both aromatics and liquids. The Fischer-Tropsch liquid fell between these two types. The temperature effect showed the ability to vary the total liquid product of a reactant. The aromatic yield however, stayed somewhat consistent. This same behavior was also exhibited in the Fischer-Tropsch liquid. This ability to vary the yield of general products enables one to choose what products are to be produced without extensive trial and error. The space velocity effect was shown to be of only slight importance in the range studied. This does not mean the space velocity was not of importance at much higher velocities. The effect of water and additional pressure proved to be detrimental to the upgrading of the reactants. Water however, increased the total liquids product, while lowering the aromatic content. But in a large scale operation the energy required to vaporize the water would probably outweigh the economic benefit of the extra liquid production. Other conclusions are given in the report.

7089 (NP—2906256, pp vp) **Influence of changed quality on the utilization of fuel gas.** Hedden, K.; Heike, T. Apr 1981. (In German). NTIS (US Sales Only), PC A06/MF A01.

In Engler-Bunte Institute of Karlsruhe University (TH).

7090 **Product compositions and kinetics for rapid pyrolysis of cellulose.** Hajaligol, M.R.; Howard, J.B.; Longwell, J.P.; Peters, W.A. (MIT, Cambridge, MA, USA). *Industrial and Engineering Chemistry Process Design and Development;* **21**: No. 3, 457-465(Jul 1982).

Systematic studies of the independent effects of temperature (300-1100°C), solids residence time (0-30 s), and heating rate (less than equivalent to 100-15000°C/s) on the yields, compositions, and rates of formation of products from the rapid pyrolysis of 0.0101 cm thick sheets of cellulose under 5 psig pressure of helium have been performed. The experiments mainly probe the primary decomposition of the cellulose, with contributions from post-pyrolysis reactions being confined to those occuring within and closely proximate to the sample. Temperature and sample residence time are the most important reaction conditions in determining the pyrolysis behavior, while heating rate effects are explicable in terms of their influence on these two parameters. A heavy liquid product of complex molecular composition accounted for 40 to 83 wt % of the volatiles above 400°C. Secondary cracking of this material increased with increasing residence time or temperature and was a significant pathway for producing several light gases. 9 refs.

7091 **Biogas in China.** Lovejoy, D. (United Nations, New York, NY). pp 367-376 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The main differences between Indian and Chinese biogas digesters are discussed in this newsletter. Both digesters have advantages and disadvantages. In building a biogas digester, consideration should be given to local conditions, materials available, the experience and skill of the builder, the expenditure involved, and the other similar circumstances. These considerations are discussed with reference to the Chinese Biogas Program. (RJC)

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 6718, 7892

7092 **(DOE/ID/12336—T1) Process for efficient fermentation and distillation for alcohol. Final report, 12 August 1981-15 June 1982.** DeLair, C.M. (ADESCO, Tucson, AZ (USA)). Jun 1981. Contract FG07-81ID12336. 21p. NTIS, PC A02/MF A01. Order Number DE83003226.

The feasibility of a vapor-compression distillation column in conjunction with continuous fermentation is studied. The distillation process was studied and a small scale distillation model was constructed and tested. (MHR)

7093 **Net energy analysis of methanol and ethanol production.** Perez-Blanco, H.; Hannon, B. (Oak Ridge Natl Lab, TN, USA). *Energy (Oxford);* **7**: No. 3, 267-280(Mar 1982).

Methanol (MeOH) and ethanol (EtOH) are industrial alcohols that can be used as liquid fuels. They may be obtained from renewable or non-renewable feedstocks. The production processes and end uses are analyzed in order to assess the potential energy savings introduced by alcohol production from renewable instead of nonrenewable feedstock. Whereas MeOH production from wood brings about energy savings, EtOH production from corn may or may not save energy depending on the end use of the alcohol. If the alcohol is used as a motor fuel, no overall energy savings are found. The economics and total labor requirements of each process are also considered. 27 refs.

0903 Inorganic Hydrogen Compound Fuels

7094 **(AD-A—114868/3) Fundamental studies of the structure and chemistry of solid surfaces. Final report 1 Jul 77-31 Dec 80.** Merrill, R.P. (Cornell Univ., Ithaca, NY (USA). School of Chemical Engineering). 31 Dec 1980. 5p. NTIS, PC A02/MF A01.

The objective of this project was to examine the decomposition of hydrazine on iridium from a molecular point of view. An understanding of the decomposition reaction is critical to the development of catalytic thruster engines which are less prone to catalyst deactivation and poisoning than present devices. The surface techniques employed to follow the reaction included reactive molecular beam scattering, temperature, programmed desorption, Auger spectroscopy, X-ray photoelectron spectroscopy, and ultraviolet photoelectron spectroscopy. These techniques allowed determination of most of the salient features of the reaction sequence of hydrazine decomposition on the (111) face of iridium. At least three parallel channels for the production of NH3 were found. Branching ratios and time constants were determined for each of these reactions. The results clearly indicated which reaction mechanism is responsible for thruster 'lights-off' as well as indicating a mechanism for catalyst decomposition and break-up.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 7138, 7735, 7857, 7858, 7859, 7869

0905 Liquid Waste Fuels

REFER ALSO TO CITATION(S) 7277

13 HYDRO ENERGY

1301 Resources And Availability

REFER ALSO TO CITATION(S) 7257, 7258

7095 **(NP—2750317) Hydroelectric power in Greenland.** (Akademiet for de Tekniske Videnskaber, Lyngby (Denmark)). 1981. 66p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750317.

Five papers on the possibilities to utilize hydroelectric power in Greenland are presented. It is concluded that water power represents a very extensive energy source, which until now is unutilized, and that future exploitation will create different kind of problems. Hydrological reservoirs are typically located where they can be used for energy supply to local city communities. The necessary technology is well-known. However, the very large energy resources are bound to the inland ice and its melt water. Probably the exploitation of this energy will be in connection with future, large industrial plants.

7096 (NP—2750317, pp 31-52) **Pilot study of hydroelectric power stations in Greenland.** Buch, D. (Groenlands Tekniske Organisation, Copenhagen, Denmark). 1981. (In Danish). NTIS (US Sales Only).

In Hydroelectric power in Greenland.

A description is given of pilot studies of the possibilities to build hydroelectric power stations in Greenland. The studies comprise hydrological, meteorological, and topographical investigations and technical aspects of construction.

7097 (NP—2750317, pp 53-66) **Possibilities for exploitation of the Greenland water power.** Oelgaard, H. (Groenlands Tekniske Organisation, Copenhagen, Denmark). 1981. (In Danish). NTIS (US Sales Only).

In Hydroelectric power in Greenland.

An evaluation of the possibilities for exploitation of the Greenlond water power is given. Emphasis is put an technical and economical aspects. It is the authors believe that the first Greenland hydroelectric power plants will be small plants for the cities energy supply. In the longer run industries based on water power can be expected.

1302 Site Geology And Meteorology

7098 (NP—2750317, pp 15-29) **Geological and glaciological prerequisites for exploitation of water power in Greenland.** Weidick, A. 1981. (In Danish). NTIS (US Sales Only).

In Hydroelectric power in Greenland.

Geological and glaciological prerequisites for exploitation of water power in Greenland are reviewed. The main theme for the glaciological work is documentation of changes in the glaciers area. Changes in the glaciers area express changes in the mass balance of the glaciers, i.e. changes in the ratio of added accumulated snow to liberated melt water and calved ice production. Different types of water reservoirs are reviewed.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 7333, 7334, 7336

7099 **(DOE/RA/23211—3) DOE small-scale hydroelectric demonstration program. F.W.E. Stapenhorst Inc., Goodyear Lake hydroelectric-generating-station redevelopment. Second annual report, operating year 2, August 11, 1981-August 10, 1982.** (F.W.E. Stapenhorst, Inc., Pointe Claire, Quebec (Canada)). 1982. Contract FC07-79RA23211. 215p. NTIS, PC A10/MF A01. Order Number DE83003156.

Portions of document are illegible.

Monthly and year-long data are presented on the performance, maintenance, power generation, flow conditions, and operating costs during the period from August 11, 1981 to August 10, 1982 at the Goodyear Lake (New York) small-scale hydroelectric power plant. During this period the plant generated 5,806,500 kWh of power for a total income of $194,401, which represents approximately 79% of predicted values. The shortfall in output resulted from the failure of Generator Unit No. 1 which was out of operation for two months. (LCL)

7100 **Optimization of short-term scheduling of EDF hydraulic valleys with coupling constraints: the Ovide model.** Merlin, A.; Lauzanne, B.; Maurras, J.F.; Auge, J.; Ziglioli, M. pp 345-354 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A model of short-term scheduling of hydroelectric generation means is described. This model has been used by EDF control center in Marseille (France) since the beginning of 1980 to operate the Durance-Verdon hydraulic complex. The energy generated by the hydraulic reservoirs during the week is provided by an annual predictive management model and are, therefore, considered the given data of the problem. The scheduling of the hydraulic plant's production is optimized for all of the valleys of the same area in reference to the thermal cost for a one-week period and then for a day. The formulation leads, with the assumption of fixed head hydro-plant, to solving a large-scale linear program having a particular structure. Use is made of the structure in the resolution method due to the technique of partitioning of the constraint matrix and to graph theory.

7101 **Short-term scheduling of multireservoir hydroelectric power systems.** Lekane, T.M. (Societe de Traction et d'Electricite, Brussel, Belgium). pp 375-382 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The problem of optimally scheduling the weekly operation of multireservoir system is discussed. The model determines the hourly plant releases which minimize the variations of residual demand to be satisfied by the thermal system while meeting the reservoir operating constraints and flow-times between plants. The problem is formulated as a large scale nonlinear network program with a quadratic objective function. The solution procedure is a reduced gradient type algorithm taking advantage of the structure of the constraint matrix. Computational experience with a real life problem involving 2160 variables and 720 constraints is presented.

7102 **Operational hydropower station control soft ware.** Jyrnov, V.L.; Lebedeva, V.D.; Malinin, N.K.; Obrezkov, V.I.; Tyagunov, M.G.; Philippova, T.A. pp 402-413 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The developemnt and use of control systems for the automation of hydroelectric power plants, and the computer programs for accessing information and for processing input data in order to achieve this automation are discussed. (LCL)

7103 **Computer simulation of hydro plant level control system.** Sucena Paiva, J.P. (Instituto Superior Tecnico, Lisbon, Portugal); Hipolito, J.; Boas, P.V. pp 469-473 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In a run-of-river hydro power plant it is desirable to implement a reservoir level control system, in order to maximize the output power for the available water flow. The control system acts upon the generating sets and flood gates in order to keep the level within a narrow tolerance margin, around the prescribed set point. The paper deals with the off-line computer dynamic simulation of the real time microcomputer-based control system, which enables the tuning of the control program, and the determination of a suitable strategy for the operation of the flood gates. The performance of the automatic control for a real flood, which occured in February 1979 is presented.

1305 Economics And Management

REFER ALSO TO CITATION(S) 7099, 7771

1307 Power Conversion Systems

7104 **(TVA/OP/FHP—82/11) EPRI hydro operation and maintenance workshop. Turbine-guide-bearing sleeve repairs and replacement; water-lubricated bearings - TVA hydro plants.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Fossil and Hydro Power). 30 Sep 1982. 20p. NTIS, PC A02/MF A01. Order Number DE83900464.

Portions of document are illegible.

Problems encountered in the maintenance and repair of turbine guide bearing shaft sleeves in TVA hydro plants which use water-lubricated bearings are discussed. (LCL)

7105 **Field testing and optimising efficiency of hydro turbines.** Sheldon, L.H. (US DOE, Idaho Falls, Idaho, USA). *International Water Power and Dam Construction;* **34**: No. 1, 22-28(Jan 1982).

An outline is given of the advantages and techniques of conducting both absolute and relative efficiency tests of hydraulic turbines. It is suggested that organizing a team to carry out index testing throughout the USA could increase the nation's output considerably. 9 refs.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 8603

7106 **(BMFT-FB-T—82-070) Determination of climatological parameters of global radiation and direct solar radiation for horizontal, not horizontal, fixed and normal incident radiation absorber.** Manier, G.; Fuchs, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1982. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750698.

The data aquisition system for global and diffuse radiation on horizontal (4 receivers) inclined (4 receivers) and normal incident surfaces has been working faultlessly since 1.11.1979. Half-hourly sums of global, diffuse and direct solar radiations as well as the time percentage of direct solar radiation, the duration, mean duration and scattering of periods of sunshine are calculated by computer. The investigations on the relationship between direct and diffuse solar radiation and synoptic weather observations are now based on measurements taken over 8 years. The differences between measured and calculated monthly sums of radiation are always smaller than 0,5 kWh/m^2.

7107 **1981 Annual status report: solar energy.** Luxembourg; Commission of the European Communities (1982). 13p. (EUR—7920-EN). European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

The Solar Energy Programme being performed by the European Community is structured into four projects: Project ESTI (European Solar Test Installation), Project Habitat and Low Temperature Applications, Project Solar Power Plants: Materials, and Project Photoelectrochemistry and Photochemistry. Results from each of these projects are presented. Project ESTI deals with the realization and operation of a large indoor and outdoor testing facility for thermal collectors and photovoltaic converters. Project Habitat studies and models integrated systems for heating and cooling. Project Solar Power Plants: Materials aims to improve the performance of thermomechanical solar power plants through materials research for absorber surface stable at high temperatures. Project Photoelectrochemistry and Photochemistry provides orientation studies on processes for the conversion of solar energy into electrical or chemical energy either by photoelectrochemical cells, photoelectrolysis, or photoinduced splitting of water. (LEW)

1401 Resources And Availability

7108 **(EUR—7951-EN) Summary report of the CEC solar-radiation-data programme 1975-1979.** Grueber, J.W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1982. 149p. European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

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The work of Project F during the European Communities first Solar Energy Programme 1975-1979 is summarized. Project F was established as a service project to support and assist with the data requirements of the other projects within the Solar Energy Programme. The first major task was to devise an action plan based on specific user requirements and by 1 January 1978 the Commission was in a position to award twenty-three contracts to seventeen participating institutions for the period up to 30 June 1979. During the rather short eighteen months period, five important goals were achieved. The preparation and publication of the first volume of the European Solar Radiation Atlas. The improvement and extension of the existing European radiation data network. New equipment was installed at a total of 56 stations. The selection of an evaluation procedure for calculating the global irradiation on inclined surfaces. This procedure will be used during the second four-year programme for the preparation of volume two of the European Solar Atlas. The formation of Test Reference Year (TRYs) data for the purposes of data reduction and subsequent use in computational simulation of solar energy systems. Progress was reported on the development of instrumentation to perform a spectral analysis of solar radiation, and early results from the work on satellite imagery revealed great promise.

7109 **(Juel-Spez—146, pp 108-110) Heat output calculations with reduced meteorological data sets.** Pilatte, A.; Koch, H.R.; Scheller, W. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

7110 **(TVA/OP/ECR—81/104) Solar-resource data for various angles of slope and azimuth in the Tennessee Valley Region.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Conservation and Rates). May 1981. 131p. NTIS, PC A07/MF A01. Order Number DE83900165.

The incident solar radiation available on one square foot of surface for various angles of azimuth and slope was computed using the FCHART version 3.0 radiation processor. The TVA Architectural Design Branch Climatic Data Bases for eight Valley cities were used as input data. These data come from National Oceanic and Atmospheric Administration documents. Annual, heating season, and monthly charts were produced for each city. These charts may be used to estimate the available solar resource for a solar energy application. This knowledge is a good starting point in the design process.

1403 Economics

REFER ALSO TO CITATION(S) 7111

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 7151, 7169

7111 **(PB—82-208638) Analysis of the california solar tax credit: 1978 returns. Final report.** Rains, D.W. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Aug 1980. 90p. NTIS, PC A05/MF A01.

Realizing the potential of solar energy use for reducing nonrenewable energy resources demand, the California Legislature enacted legislation in 1977 to encourage the accelerated use of solar energy. This report summarizes the results of the second year of California's 55 percent Solar Energy Income Tax Credit. The 1978 tabulations presented actually represent the first full year of data available from the credit. In addition, this analysis also reflects the first year of interaction between the California Solar Energy Tax Credit and the federal Energy Tax Act of 1978.

7112 **Environmental assessment for the satellite power system concept development and evaluation program.** Abromavage, M.M. (Illinois Institute of Technology, Chicago, Ill.); Valentino, A.R. (Argonne National Laboratory, Argonne, Ill.). *AIAA Paper;* No. 81-0244, vp(1981). (CONF-810106—).

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

A 3-year environmental assessment of the satellite power system energy concept has been completed. Potential environmental effects and candidate mitigating strategies have been identified. The important effects which depend upon satellite and energy transmission design are: Low-level long-term microwave exposure to the public, ionizing radiation exposure to workers in space, space transportation exhaust effluent effects in the atmosphere, and electromagnetic compatibility impacts at geostationary earth orbit locations, in the ionosphere, and on earth. These potential effects would influence any further development of the satellite energy concept, including design preferences, energy transmission principles, and system construction, operating and maintenance scenarios.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 6784, 7090, 7091, 7092, 7221, 7769, 7771, 7776, 7869, 7893, 8099, 8360, 8363, 8398, 8399

7113 **(BMFT-FB-T—82-079) Research and development on a MIS thin film solar cell made of amorphous silicon.** Jaeger, H.; Bonnet, D.; Roessler, W.; Brunsmann, U.; Fuessl, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750724.

The deposition of hydrogenated amorphous silicon layers can be achieved by glow-discharge decomposition of SiH_4 gas and by sputtering from Si-cathodes in Ar-H_2 mixtures. Both methods yield highly photoconducting layers. The work presented here is concerned with sputter-deposition of a-Si:H layers. In deviation from earlier work this has been performed using a magnetron Si-cathode. This allows working at much lower dc voltages, which is advantageous for the quality of the films. The photovoltaic characteristic of the layer is always considered as the crucial property and guide for the development. Photovoltaic barriers were mainly Au Schottky barriers. First structures yielded open circuit voltages of up to 570 mV and short circuit current densities of 1 mA/cm^2. This report marks the end of a first phase of work, from which several possible improvements of the layer-quality have been deduced. They are to be tested in a subsequent phase.

7114 **(BMFT-FB-T—82-081) Solar energy conversion on the principle of fluorescent collectors.** Baur, G.; Goetzberger, A.; Heidler, K.; Langhals, H.; Sah, E.; Wittwer, V.; Zastrow, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 204p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE82750725.

Emphasis of the work was the measurement and investigation of fluorescent dyes and matrix materials with regard to an application in fluorescent collectors. In the visible range new dyes from the field of display applications were available. In this spectral range the combination organic dye-plexiglas can give satisfactory results concerning efficiency as well as stability, both of which have been improved in the last two years. At the moment, however, a commercial application is not yet possible. The first collectors are being tested in a long term outdoor test set-up. In the red and infrared range, the properties of dyes and collectors are not yet satisfactory. A special program for dye development in this spectral range was started in spring 1980 by the chemical industry.

7115 **(DOE/ER/10815—1) Applications of photoinduced electron transfer and hydrogen abstraction reactions to chemical and electrochemical conversion processes. Progress report, March 1, 1981-September 1, 1982.** Whitten, D.G. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 1982. Contract AS05-81ER10815. 22p. NTIS, PC A02/MF A01. Order Number DE83002961.

The major goal of this research as outlined in our proposal is to study light-driven electron transfer and hydrogen atom abstraction processes with a particular emphasis on reactions giving rise to net chemical or electrochemical conversion. During the past eighteen months we have obtained results of some significance in each of the five areas which are discussed individually in the report: (1) generation and reaction of reducing and oxidizing radicals and radical ions in photoelectrochemical cells; (2) studies of Weitz-type quenchers having stable one-electron redox products; (3) two-electron oxidative and reductive quenching processes with Weitz-type systems in solution and organized media; (4) photoredox reactions of indigo dyes; and (5) modification of photochemical reactivity by formation of amylose inclusion complexes in aqueous and partially aqueous solutions.

7116 **(DOE/ET/20598—T1) Evaluation and modeling of tree-biomass yields from small-diameter conifer stands in the Inland Northwest. Final report.** (Washington State Univ., Pullman (USA). Dept. of Forestry and Range Management). 1982. Contract FG01-78ET20598. 39p. NTIS, PC A03/MF A01. Order Number DE83003636.

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Models are presented for estimating: individual tree green and oven dry bole biomass; individual tree green and oven dry above ground biomass; distribution of oven dry weight along the bole as a function of the attained inside bark diameter; oven dry weight of branches; total cubic foot volume of the bole; and bole over dry weight as a function of diameter, and cubic foot volume. Biomass subroutines have been developed which when added to the Growth Prognosis Model provide estimates of oven-dry bole and total above ground biomass. (MHR)

7117 **(DOE/ET/23043—T2) Chalcogenide-glass solar cells. Quarterly technical report No. 2, January 1, 1980-March 31, 1980.** Adler, D.; Haggerty, J.S. (Massachusetts Inst. of Tech., Cambridge (USA)). 1980. Contract AC03-79ET23043. 30p. NTIS, PC A03/MF A01. Order Number DE82021243.

The purpose of the program reported is to determine if several disadvantages of chalcogenide glasses for solar cell applications can be overcome by chemical modification. These problems include a pinned Fermi energy, low carrier lifetime, and the presence of geminate recombination for photon frequencies just above the optical bandgap which reduces the overall quantum efficiency. Emphasis is on the selenium-tellurium system. The tasks reported were: to try to overcome the transient effects by stabilizing the glass with a modifier such as arsenic, to reactively sputter the glass in hydrogen/argon mixtures to ascertain whether the introduction of hydro-

gen would serve to reduce the defect density, and to co-sputter the glass with lithium in an attempt to unpin the Fermi energy of the glass and obtain a low-resistance back contact for solar cells. Stabilization was accomplished with only 1% arsenic. It is found that hydrogenation increases the resistance somewhat and leads to non-ohmic behavior at a lower applied field; however the photoconductivity and the spectral response of the photocurrent are degraded. (LEW)

7118 (DOE/JPL/955392—1) Development of photovoltaic array and module safety requirements. Flat-plate solar array project, engineering sciences area. Final report. Levins, A. (Underwriters Lab., Inc., Melville, NY (USA). Research Dept.). Jun 1982. Contract NAS-7-100-955392. 220p. NTIS, PC A10/MF A01. Order Number DE82020735.

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A study has been conducted to identify and develop module safety requirements for photovoltaic module and panel designs and configurations likely to be used in residential, intermediate, and large-scale applications. The National Electrical Code and Building Codes were reviewed with respect to present provisions which may be considered to affect the design of photovoltaic modules. Limited testing, primarily in the roof fire resistance field was conducted. The generation of engineering safety requirements included a safety workshop which encompassed a broad cross-section of the photovoltaic community. Comments from the workshop resulted in additional studies and further investigations which led to the development of a UL Proposed Standard for Safety - Flat-Plate Photovoltaic Modules and Panels. Additional work covered the initial investigation of conceptual approaches and temporary deployment, for concept verification purposes, of a differential dc ground-fault detection circuit suitable as a part of a photovoltaic array safety system.

7119 (DOE/JPL/955699—81/05) Equipment development for automated assembly of solar modules. Final report. Hagerty, J.J. (Tracor MBA, San Ramon, CA (USA)). Jan 1982. Contract NAS-7-100-955699. 174p. NTIS, PC A08/MF A01. Order Number DE83003070.

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Prototype equipment was developed which allows for totally automated assembly in the three major areas of module manufacture: cell stringing, encapsulant layup and cure and edge sealing. The equipment is designed to be used in conjunction with a standard Unimate 2000B industrial robot although the design is adaptable to other transport systems.

7120 (DOE/JPL/956061—5) Flat-plate solar-array project silicon material task. Task I. Silicon material. Investigation of the hydrochlorination of $SiCl_4$. Fifth quarterly report, July 9-October 8, 1982. Mui, J.Y.P. (Solarelectronics, Inc., Bellingham, MA (USA)). 15 Oct 1982. Contract NAS-7-100-956061. 27p. NTIS, PC A03/MF A01. Order Number DE83002787.

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Work has been extended to further the basic experimental study on the hydrochlorination of $SiCl_4$ and m.g. silicon metal to produce $SiHCl_3$. The extended research and development work includes reaction kinetic measurements at the higher temperature range (up to 650°C). These additional kinetic data are needed for the theoretical study to develop a rate equation and to determine important thermodynamic functions, such as, ΔH and ΔE. A reaction mechanism study includes experiments on the deuterium kinetic isotope effects. An experimental study on the effect of catalysts and impurities on the hydrochlorination reaction is also planned. The objective is to provide a basic understanding on the nature of the catalyst and to search for a still more effective catalyst for the hydrochlorination reaction. Reaction kinetic measurements on the hydrochlorination of $SiCl_4$ and m.g. silicon metal were carried out at two higher temperatures, 550°C and 525°C, and at two pressure ranges, 200 psig and 100 psig. These higher reaction temperature data are also used in the theoretical study for the development of a kinetic model and a rate equation for the hydrochlorination reaction. Preliminary results on the theoretical treatments of reaction rate data at 550°C, 50°C and 450°C show that the rate of formation of $SiHCl_3$ follows a psuedo-first order kinetics. The rate constants at these three temperatures and the activation energy, ΔE, are calculated and reported. The design of a quartz hydrochlorination reactor for the planned experiments on deuterium kinetic isotope effects has been completed. This quartz reactor can also be used to measure reaction rate and the equilibrium conversion of $SiHCl_3$ at the higher temperature range where the present stainless steel reactor becomes unusable. More experimental work is in progress.

7121 (LBL—15063) High-resolution study of the chalcocite (Cu_2S)-djurleite ($Cu_{1.97}S$) transformation in Cu/sub 2-x/S thin films. Sands, T.D.; Gronsky, R.; Washburn, J. (Lawrence Berkeley Lab., CA (USA)). Oct 1982. Contract AC03-76SF00098. 23p. (CONF-820906—31). NTIS, PC A02/MF A01. Order Number DE83003275.

From 16. IEEE photovoltaics specialists conference; San Diego, CA, USA (28 Sep 1982).

High resolution transmission electron microscopy (HREM) has been applied to the study of the microstructural evolution of copper sulfide thin films. Both separated and supported Cu/sub 2-x/S thin films were prepared by the wet process on the (0001) and (000$\bar{1}$) faces of CdS single crystals. HREM of as-plated films show that they are entirely low chalcocite with heavy faulting on (040)'. Degradation to djurleite-digenite mixtures occurs over a period of several days at 20°C for separated films. An atomic model of this transformation is presented and the effect of interfacial strain on the stability of copper sulfide layers is discussed.

7122 (LBL—15143) Products of direct liquefaction of biomass. Davis, H.G.; Eames, M.A.; Figueroa, C.; Gansley, R.R.; Schaleger, L.L.; Watt, D.W. (Lawrence Berkeley Lab., CA (USA)). Oct 1982. Contract AC03-76SF00098. 19p. (CONF-821051—3). NTIS, PC A02/MF A01. Order Number DE83003758.

From International conference on fundamentals of thermochemical biomass conversion; Estes Park, CO, USA (18 Oct 1982).

Several methods of characterizing products of biomass liquefaction including GC-MS, wet analysis, infrared and various forms of liquid chromatography have been tried. Of these the SESC sequential elution technique has been particularly helpful in separating whole product oils into chemically distinguishable fractions. Variations in the distribution of SESC fractions have been used to show effects of changing conditions and changing feedstocks in biomass liquefaction. They have also been used to follow the effects of catalytic hydrogenation. Liquefaction of aspen results in higher yields than liquefaction of Douglas fir. The aspen oil product is richer in SESC fractions 1-4, is more fluid and has lower oxygen content. Catalytic hydrogenation is effective in increasing the percentage of oil in the more volatile SESC fractions 1-4.

7123 (PB—82-205048) Industrial technology for the economic and viable encapsulation for large-scale solar panels (technologie industrielle d'encapsulation economique et fiable pour panneaux solaires de grandes dimensions). Final report. Anguet, J.; Salles, Y. (Commission of the European Communities, Luxembourg). [nd]. 22p. NTIS PC E02/MF E02.

The aim of the work is to apply the laminated glass technology used in buildings and car windscreens to the encapsulation of solar panels so as to form a glass-polyvinylbutyral-glass 'sandwich'. Based on small-scale experimental panels, the following studies were made: (1) adhesion techniques; (2) structure studies to find the most suitable means for maintaining the mechanical stability of the cells; (3) types of connections for the solar panels and (4) climatic tests and humidity resistance. Mechanical and climatic tests with the minimodules gave encouraging results, whereupon larger scale models were designed. The results obtained with these confirmed those obtained with the mini-modules.

7124 (PB—82-208117) Biomass handbook for the Biomass Conversion Demonstration Program. Final report. Wang, D.; Smith, K.D.; Vann, L.G. Jr; Fong, D. (Envirosphere Co., New York (USA)). Nov 1980. 102p. NTIS, PC A06/MF A01.

The California Energy Commission is charged with the responsibility of implementing the State Agricultural and Forestry Residue Utilization Act of 1979. The preparation of a handbook which serves as a primer to the utilization of biomass residues for energy conversion is a result of this responsibility. The purpose of the handbook is to encourage biomass utilization by educating both professional energy engineers and potential energy users in the agricultural and industrial sectors. The handbook briefly describes the factors that must be considered in a preliminary evaluation of a biomass energy system. This includes discussion of the biomass resource base, residue collection and storage, potential biomass energy recovery, conversion technologies (direct combustion, gasification, and methane fermentation), pollution control measures, economics, and regulatory requirements.

7125 **(PB—82-214149) Program negative declaration for the Biomass Conversion Demonstration Program. Final report.** (Envirosphere Co., New York (USA)). Sep 1980. 332p. NTIS, PC A15/MF A01.

In accordance with the State Agricultural and Forestry Residue Utilization Act (SAFRUA), the California Energy Commission is implementing the Biomass Conversion Demonstration Program by offering supporting funding to selected energy projects that will convert agricultural and forestry residues to a usable energy form. The conversion processes include, but are not limited to, combustion, gasification, and methane fermentation. The purpose of this document is to describe the types of biomass projects that could be partially funded by the CEC pursuant to the SAFRUA, indicate the type of environmental setting into which such projects could be placed in the State of California, and provide supporting information for the conclusion that certain of these projects will not have any potentially significant environmental impacts. Significant environmental impacts could be associated with some biomass projects if they are of large size or are sited in sensitive areas. The impacts of these projects can only be properly addressed in project-specific environmental investigations. However, a large number of moderately sized biomass-fueled projects, if properly sited and in compliance with all applicable regulations, would not have any potentially significant environmental impacts. This latter group is addressed in this document.

7126 **(PB—82-214156) Program negative declaration for the Biomass Conversion Demonstration Program (Appendices).** (Envirosphere Co., New York (USA)). Sep 1980. 158p. NTIS, PC A08/MF A01.

This Initial Study was prepared in accordance with CEQA, the State's CEQA implementing regulations and the general requirements of the California Energy Commission (CEC). The purpose of this Study is to identify any potentially significant environmental impacts, to identify and document insignificant impacts, and to focus the scope of further environmental assessments for the Biomass Conversion Demonstration Program. A further purpose of this document is to provide organizations planning energy projects with technical information regarding the use of biomass as an energy resource. Because of the nature of the Biomass Conversion Demonstration Program, this Initial Study must address not only the potential environmental impacts associated with individual biomass projects, but also the cumulative impacts of biomass projects that are likely to be constructed in the reasonably forseeable future. Given the uncertainties associated with any type of industrial development, the reasonably foreseeable future is a time period of approximately ten years duration. If necessary, consideration should be given to updating this document at the end of this period.

7127 **(SERI/PR—9330-1-T8) Preparation and properties of evaporated CdTe films compared with single-crystal CdTe. Progress report No.8, August 1-October 31, 1982.** Bube, R.Hl. (Solar Energy Research Inst., Golden, CO (USA)). 1982. Contract AC02-77CH00178. 19p. NTIS, PC A02/MF A01. Order Number DE83002252.

The goal of the research is to develop efficient thin-film CdTe solar cells using the method of hot-wall vacuum evaporation for CdTe film deposition. A series of undoped CdTe film depositions was performed. Ampoules with small apertures were designed for Zone 3 and Zone 4 of the furnace (dopant zone, and Cd or Te zone) to allow the temperatures of these zones to be raised near that of the substrate and thus prevent deposition of Te in these zones during a deposition run. Weighing these ampoules also provides a convenient test of material evaporated. The first set of depositions with As impurity to produce p-type CdTe:As films was carried out. No large effect of As doping was observed in these early runs, but some system improvements have been made for the future. A CdTe homojunction with a 0.15 μm n-type CdTe:In layer on a p-type CdTe:P single crystal substrate has been analyzed. Modelling of the spectral response of the quantum efficiency suggests the presence of a thin inactive layer at the surface, possibly a depletion layer in the n-type film. Large values of the diode factor A indicate non-simple homojunction structures. A light spot scanning apparatus has been constructed using a He-Ne laser and a 4 μm optical fiber. This apparatus will be used to measure the recombination characteristics of grain boundaries covered by transparent Schottky barriers. The electrical conductivity of p-type CdTe films prepared by close-spaced vapor transport is markedly increased by heat treatment in H_2. Some recovery of the film resistivity is seen after 1 week in air.

7128 **Studies on photoelectrochemical properties of SnO/sub 2/ films prepared from organic resinate solution.** Stilwell, D.E.; Park, S.M. (Univ of NM, Albuquerque, USA). *Journal of the Electrochemical Society;* **129**: No. 7, 1501-1506(Jul 1982).

Tin oxide (SnO/sub 2/) thick films have been prepared on glass surfaces from organometallic tin resinate solutions, and their photoelectrochemical properties have been studied. The antimony-doped tin oxide film showed similar photoelectrochemical properties to those of the n-SnO/sub 2/ single crystal electrode. No anodic dark current was observed for the electrolysis of water up to the bias potential of 2.0V vs. SCE and saturation currents were observed upon illumination. These and other results indicate that SnO/sub 2/ films prepared from the resinate show purer semiconducting properties with less degenerate energy levels than those prepared from aqueous SnCl/sub 4/. Possible reasons are discussed from experimental observations. 25 refs.

7129 **Semiconductor electrodes - 46. Stabilization of n-silicon electrodes in aqueous solution photoelectrochemical cells by formation of platinum silicide layers.** Fan, F.R.F.; Hope, G.A.; Bard, A.J. (Univ of Tex, Austin, USA). *Journal of the Electrochemical Society;* **129**: No. 7, 1647-1649(Jul 1982).

Platinum silicide-coated n-Si electrodes have been shown to give highly stable photoelectrochemical (PEC) performance in aqueous solutions. The exceptional stability and performance of these PEC cells might be due to the following: (1) fast interfacial charge transfer kinetics between the n-Si substrate and the platinum silicide and between platinum silicide and solution redox species; (2) separation of region of photocharge carrier generation from solution contamination; (3) good mechanical stability of the silicide on the silicon substrate; (4) reasonable chemical and electrochemical stability of the silicide. 10 refs.

7130 **Surface-modified p-InP photocathodes in sulfide/polysulfide electrolyte.** Liu, C.J.; Ang, P.G.P.; Sammells, A.F. (Inst of Gas Technol, Chicago, IL, USA). *Journal of the Electrochemical Society;* **129**: No. 6, 1387-1389(Jun 1982).

A chemical procedure is reported to modify the semiconductor surface which results in an efficient p-InP/S/sup 2-/,Sx/sup 2-/ photoelectrochemical cell. The procedure is as follows: The p-InP electrode was initially etched in 12M HCl for 1-2 minutes, followed by immersion in polysulfide solution (1M Na/sub 2/S+1M/sub 2/S or 2.5M Na/sub 2/s+1M S+1M NaOH. To the polysulfide-wetted surface of the p-InP, a drop of 0.2M CoCl/sub 2/ was added. A black precipitate of cobalt sulfide was immediately formed, the majority of which was rinsed off with deionized water. 7 refs.

7131 **Charge transfer in photoelectrochemical devices via interface states - unified model and comparison with experimental data.** Rajeshwar, K. (Colo State Univ, Fort Collins, USA). *Journal of the Electrochemical Society;* **129**: No. 5, 1003-1008(May 1982).

A simple, unified model is presented for the mediation of charge transfer across the semiconductor/electrolyte interface by states localized in the bandgap of the semiconductor. These states are interpreted to arise from specific adsorption of anionic species from the electrolyte. The adsorbed ions could be either one of the components of a regenerative redox couple or comprise the constituent ions of the supporting electrolyte. The role of the interphasial layer in photoelectrochemical (PEC) devices is examined in the light of the above model. The key factor in determining the efficacy of energy conversion in the PEC system is identified as the competition between tunneling of photogenerated holes across the interphasial layer and their recombination with the majority carriers in the semiconductor conduction band. The extent of matching between the interface state and the reduced (filled) energy levels in the electrolyte is shown to be important in this regard. Experimental data on the n-GaAs/room temperature molten salt electrolyte and the n-CdSe/polysulfide interfaces are discussed in the light of this model. 28 refs.

7132 **Solid polymer electrolyte photovoltaic cell.** Skotheim, T.; Lundstrom, I. (Linkoping Inst of Technol, Swed). *Journal of the Electrochemical Society;* **129**: No. 4, 894-896(Apr 1982).

Solid photoelectrochemical cells are described based on PEO-KI/I_2 electrolytes, n-Si/Pt/PPy photoanodes, and conductive tin-oxide glass counter electrodes. The performance of the present devices is limited by a high series resistance in the polymer film. 22 refs.

7133 **Ineffectiveness of low-high junctions in optimized solar cell designs.** Weaver, H.T. *Solar Cells;* 5: No. 3, 275-292(Mar 1982).

Exact numerical calculations for the back-surface field (BSF) type of silicon solar cell show that the base doping level for optimum overall performance is sufficiently high that the BSF is essentially ineffective. This implies that an optimized conventional cell will perform roughly as well as a BSF design and accounts for the fact that the highest efficiency cells to date have low resistivity bases. A second generic cell type, the high-low emitter, is also modeled. Again, no significant advantage of this cell over the conventional device is found. Summaries of optimized design performances of the different cell types are given. 30 refs.

7134 **Plastic Schottky-barrier solar cells.** Waldrop, J.R.; Cohen, M.J. (to Dept. of Energy). US Patent Application 335,994. 30 Dec 1981. 15p. Contract AC02-79ET23002.

A photovoltaic cell structure is fabricated from an active medium including an undoped polyacetylene, organic semiconductor. When a film of such material is in rectifying contact with a metallic area electrode, a Schottky-barrier junction is obtained within the body of the cell structure. Also, a gold overlayer passivates a magnesium layer on the undoped polyacetylene film. With the proper selection and location of elements a photovoltaic cell structure and solar cell are obtained.

7135 **U.S. Department of Energy collector cost reduction program.** Magid, L.M. (U.S. Department of Energy, Div. of Photovoltaic Energy Systems, Washington, DC). pp 158-165 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Co. (1981).

From 1980 photovoltaic solar energy conference; Cannes, France (27 Oct 1980).

A program conducted by the United States Department of Energy that focuses on the basic research and technology development required to reduce the price of photovoltaic collectors is reviewed. Analysis of the current status of the flat-plate and concentrating collectors and projected status of the photovoltaic collector cost reduction efforts, both for flat-plate and concentrating collectors indicates that the photovoltaic industry should easily be able to meet the 1982 goal of $2.80/Wp collectors. Significant progress is also apparent toward the longer-range $0.70/Wp and $0.15-0.40/Wp goals.

7136 **Photovoltaic R D program overview.** Feucht, D.L. (Solar Energy Research Institute, Golden, CO). pp 199-203 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Co. (1981).

From 1980 photovoltaic solar energy conference; Cannes, France (27 Oct 1980).

The current status of a research and development program conducted under contract to the U.S. Department of Energy to develop low cost solar cells ($0.15-0.40/Wp modules in 1980$) is reviewed. The emphasis of the program is on thin film and electrochemical cells with conversion efficiencies greater than 10% and multijunction cells with conversion efficiencies greater than 30%. The R D efforts include research on polycrystalline silicon, amorphous materials, cadmium sulfide cells, gallium arsenide cells, emerging materials, and advanced concentrator and cell concepts.

7137 **Current United States activities in photovoltaics consensus standards.** Bishop, C.J. (Solar Energy Research Institute, Golden, CO). pp 736-740 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Co. (1981).

From 1980 photovoltaic solar energy conference; Cannes, France (27 Oct 1980).

The standards are being worked out by subcommittees of the American Society for Testing and Materials (ASTM) and the Institute of Electrical and Electronic Engineers (IEEE). The ASTM work has been devoted to test methods and specifications for standardizing the measurement and reporting of photovoltaic device performance. The efforts of IEEE deal with energy/power rating, reliability, and interface issues related to photovoltaic components and systems. It is pointed out that progress has been greatly assisted by the Interim Performance Criteria programs sponsored by the Department of Energy/Solar Energy Research Institute. The work coming out of the program has in many instances greatly accelerated the consensus standard process.

7138 **Transferring appropriate energy technologies to developing countries: two hot prospects.** Lucarelli, B. pp 245-255 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The purpose of this paper is to examine the potential for two improved appropriate energy technologies for transfer to developing countries and barriers to their transfer. The two devices are: the Taiga Mod-Log machine - a small-scale, transportable biomass densification system; the Sanimatic - a rubber anaerobic digester. The two devices were chosen because they have the potential for large energy savings and also illustrate problems faced by small business marketing products in Third World countries. (RJC)

7139 **Learning through Lorena: experiments with cookstoves in the Third World.** Childers, L.; Stea, D.; Gern, E. (APROVECHO, Eugene, OR). pp 398-405 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Appropriate technology can stimulate local creativity and self-confidence, a goal often overlooked by development programs. Instead, the introduction of a technique, appropriate or inappropriate, becomes the main objective. Often, foreign experts stifle local creativity and self-confidence by arriving abroad with blueprint solutions, sometimes solutions with no corresponding problems. Appropriate development is better done by and with community residents, who know more about local ways of doing things. In the mid 1970s APROVECHO learned these principles in the development of the highly energy-efficient sand/clay cookstoves which have come to be called Lorena. The Lorena system of design employs the heat-retaining properties of sand, bound with a minimal amount of clay. Stoves built of this mixture can be adapted to local conditions, including various fuels, cook pots, cooking customs, and heating needs. This paper is divided into several sections: the first and last deal with the way in which APROVECHO approaches development via appropriate technology; the second and third deal

with the firewood crisis, stoves generated by APROVECHO, and results of the stove-building experience. (RJC)

7140 **Biotechnology for developing countries.** Villet, R. (Solar Energy Research Inst., Golden, CO). pp 474-478 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

A trend among developing countries, often with dire consequences, has been to give precedence to so-called industrial crops. The author proposes that biomass biotechnology could offer a way out of this unrewarding situation. Biotechnological processing would be based on the selection of appropriate biomass crops. The recommended approach is that of a production-extraction-conversion system. In such a systems approach a biomass resource crop would be evaluated on the basis of several characteristics: (1) the photosynthetic efficiency; (2) the presence of extractables such as soluble sugars, oils, and proteins; (3) the ease with which biopolymers such as cellulose and hemicellulose can be converted, through biotechnological processing, to chemicals and fuels. These topics are discussed with reference to use in developing countries. (RJC)

7141 **Oilseeds for energy in rural areas of developing countries.** Shultz, E.B.; Morgan, R.P.; Draper, H.M. III. (Washington Univ., St. Louis, MO). pp 485-503 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Fuelwood shortages and rising prices of petroleum products are rapidly generating a sense of urgency in the search for practical renewable fuels for rural areas of developing countries. However, oilseeds are not yet receiving their share of attention, in comparisons with the better-known biomass options of reforestation, biogas, and ethyl alcohol. Oilseeds may be suitable for meeting many fuel needs - cooking fuel, lighting fuel, and diesel fuel as a substitute for water pumping and transport - and the authors feel that, in view of the seriousness of the deteriorating rural condition, investigation of the potential application, and the attendant benefits and disadvantages, should not be further delayed. The authors have identified and discussed ten potential advantages of oil seeds. Several of the more interesting species of plants are discussed. They are: oil palm, Chinese tallow tree, baffalo gourd, other oilseeds for dry lands, overlooked oilseeds in East Africa, and overlooked oilseeds in the Indian subcontinent. The paper concludes with a discussion on the need for further work. (RJC)

7142 **Structural building panels from fibrous agricultural residues using a new, simplified appropriate technology.** Nnabuife, E.L.C.; Bryant, B.S. (Univ. of Washington, Seattle). pp 540-553 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Many appropriate technology organizations recognize that development of new building materials must utilize the locally available raw materials. The authors chose to work with three readily available raw materials in developing countries - rice straw, coconut husk fiber (coir), and sugar cane fiber (bagasse) - that are either not utilized or at best are underutilized in most developing countries. Reported is a greatly simplified method of producing roofing materials. The process was specifically designed to be labor intensive and very low in capital investment. The thrust of the authors' current effort is to demonstrate that such a facility can be operated entirely by hand. The subject is treated as three categories: treatment of the raw materials, fiber mat making, and sulfur impregnation and corrugation. (RJC)

7143 **Supply of Douglas fir and its potential for biomass utilization.** Berck, P. (Univ. of California, Berkeley). *Biosources Digest;* 2: No. 2, 98-108(Apr 1980).

The potential of the Douglas fir for biomass utilization is examined and it is noted from price projections that diversion of the Douglas fir to biomass would have quite spectacular price effects. Demand is expected to grow substantially even without any consideration of the use for biomass conversion, while projections of supply show that prices and supply will increase because of the adoption of intensive forestry techniques.

7144 **Fuels from biomass (fermentation): USA.** Jeffries, T.; Montenecourt, B.S.; Eveleigh, D.E. (Forest Products Lab, Madison, WI). pp 226-242 of Fungal Biotechnology. Smith, J.E.; Barry, D.R.; Kristiansen, B. (eds.). London, England; Academic Press (1980).

Biotechnology in the United States has advanced broadly in such divergent areas as immobilization of whole cells and enzymes, application of computers to fermenter operation, and bio-separation technology (Wang, Lib and Hatch, 1977). One topic, the production of fuels from biomass, has received considerable emphasis as a result of the dwindling supplies of petroleum and the need to develop alternate renewable energy resources. Biomass such as forest, agricultural and animal residues, can be converted by physiochemical or fermentation processes to clean fuels, petrochemical substitutes or other energy intensive products such as ammonia. This article addresses the fermentation technologies being developed for these purposes through the Fuels from Biomass Program, US Department of Energy.

1406 Photovoltaic Power Systems

7145 **(BMFT-FB-T—82-125) Systems analysis, design, construction and commission of a photovoltaic power plant for supply of broadcasting equipment.** Keaveny, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750994.

Supported by the Federal Ministry of Research and Technology and the Commission of the European Communities a photovoltaic power plant to supply a broadcasting transmitter was designed, build and tested. The project should prove in general the application of photovoltaic power plants for the self-sufficient power supply of broadcasting equipment. The City of Berlin (51°n) was chosen as site for extensive data collection was the main goal of the field testing. A 600 W-transmitter was installed as load. After construction and commissioning the plant, consisting of the components solar generator, energy conditioning and control, storage battery, and transmitter, was proved in a one year field testing. The tests totally confirmed the expectations put to the plant, gave valuable indications to improvement, and useful experiences for the construction of similar plants. Furthermore the field testing demonstrated that also in Central European latitudes photovoltaic power plants can guarantee a self-supporting operation of broadcasting equipment. With these assumptions the criterion 'long life time' and 'reliable operation' can be transferred to plants on different location.

7146 **(DOE/ER/10159—T1) Electric power from orbit: a critique of a Satellite Power System.** (National Research Council, Washington, DC (USA). Committee on Satellite Power Systems). 1981. Contract AI01-80ER10159. 357p. NTIS, PC A16/MF A01. Order Number DE83002771.

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A Satellite Power System (SPS) would consist of a number of huge satellites moving in geosynchronous orbit and collecting solar energy for conversion and transmission to earth. Focussing on a reference system, the concept is critiqued in terms of: technological aspects, economic aspects, environmental effects, sociopolitical factors, comparison with other long-term technologies. It is recommended that no funds be committed to developing an SPS, but that progress in new technologies that would be important to the practicality and timeliness of an SPS should be reviewed and reported to Congress. Supporting information is included on space systems, solar cells, microwave energy transmission, dosimetry, long-term

effects of low-level radiation on people, and electromagnetic compatibility. (LEW)

7147 **(DOE/ET/20279—212) Effect of data-sampling rate on utility-interaction calculations.** Hart, G.W. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Oct 1982. Contract AC02-76ET20279. 31p. NTIS, PC A03/MF A01. Order Number DE83003153.

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A study has been made at the Northeast Residential Experiment Station of the relationship between photovoltaic data sampling rate and accuracy. It is shown that there is a correlation between the length of the timestep of a photovoltaic system simulation and the inaccuracy of the calculation of the utility-interactive energy flows. The longer the simulation timestep, the greater the underestimation of the energy purchased from and sold to the utility. The error results from the loss of the high-frequency components of the load and inverter power time series. In the worst case yet observed, a one-hour timestep, which is the most common size used in photovoltaic system simulation, resulted in errors of up to 50% in the calculation of utility-interactive energy flows.

7148 **(DOE/ET/20624—T1) Airport solar photovoltaic concentrator. Project status report, 1 July 1982-31 October 1982.** (Arizona Public Service Co., Phoenix (USA)). 1982. Contract AC04-80ET20624. 9p. NTIS, PC A02/MF A01. Order Number DE83003137.

The work reported was to operate and evaluate at the Phoenix Sky Harbor International Airport an 80-array photovoltaic power supply rated at 225 kW. Problems with acquiring array performance data due to a malfunction of the I-V tester are reported. System availability and energy production and usage data are listed, as is the distribution of system downtime. System operation and maintenance efforts are reported. The data acquisition system data are compared to other similar data for correlation. System performance is reported to be good, and about 320,000 kWh are expected for the first year's operation. (LEW)

7149 **(SAND—82-1811) Photovoltaic residential project: second project integration meeting.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 249p. (CONF-820887—Absts.). NTIS, PC A11/MF A01. Order Number DE83000530.

From 2. photovoltaic residential project integration meeting; Las Cruces, NM, USA (19 Aug 1982).

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Abstracts and viewgraphs of presentations given at a project review of residential photovoltaics held at the Southwest Residential Experiment Station in Las Cruces, NM are given. The proceedings emphasize recent results of field testing of residential photovoltaic systems both federally and privately funded. Status reports on systems and component technology development are also included, as well as DOE plans for continued experimentation.

7150 **Wind and solar powered reverse osmosis desalination units.** Petersen, G.; Fries, S.; Mohn, J.; Mueller, A. Geesthacht-Tesperhude, Germany, F.R.; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1982). 11p. (GKSS—82/E/12).

To demonstrate the operation of RO units with GKSS plate modules coupled with unconventional energy supply systems, two projects are presently carried out by the GKSS research center. The solar generator with a designed peak power of 2.5 kW is developed by AEG and powers a RO unit for the desalination of brackish well water. The plant has been installed in Concepcion del Oro, Zacatecas, in spring 1980 and has been operated by the Mexican company DIGAASES in cooperation with AEG and GKSS since May 1980. The second project is a 6 kW-wind energy converter supplying 3 RO-modules with a total membrane area of 30 m^3. After comprehensive component tests at the GKSS research center at Geesthacht the plant was installed at the very small island of Suederoog at the German coast of the North Sea. Test operation was started in December 1980. For both plants a measurement program has been started. Membrane based desalination processes such as reverse osmosis have become more cost effective due mostly to their increasingly efficient use of energy. However, even with improvements in RO system efficiency, power costs still account for nearly half the cost of water. Areas of the world which do not have sufficient fresh water sources often have an abundance of wind or solar insolation. Therefore, a natural means of reducing the impact of rising fuel costs is to power desalination systems with these renewable energy sources. As a first step in this direction the GKSS has initiated a R+D program concerning the application of wind and solar insolation for the energy supply of RO-plants with GKSS plate modules. The project was started in 1978 with the definition of several design alternatives for small units in the few kilowatt range. Two design systems, whose expected performance is quantified in table 1 and 2, have been established in 1979 with respect to a wind energy converter and a solar cell panel of proven design, available on the German market.

7151 **Environmental assessment of the satellite power system reference design.** Barr, N.F. (U.S. Department of Energy, Satellite Power Systems Office, Washington, D.C.). pp 441-446 of Space manufacturing III, proceedings of the fourth conference. New York, NY; American Inst. of Aeronautics and Astronautics, Inc. (1979).

From 4. Princeton/AIAA conference; Princeton, NJ, USA (14 May 1979).

The paper describes an environmental assessment program which will identify and define environmental issues associated with the installation and operation of Satellite Power Systems (SPS). A joint Concept Development and Evaluation Program (CDEP) of NASA and DOE will provide a plan for ground based R D work which will also reduce uncertainties regarding environmental impacts. Environmental problems will include: (1) microwave exposure effects on human health and ecosystems, (2) impacts of SPS launch and heat insertions on the atmosphere, and (3) effects of SPS operations on electromagnetic systems and use of the radio spectrum.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 7754

7152 **(DOE/NBM—3002230) Effect of sunshape on flux distribution and intercept factor of the solar tower power plant at Almeria. SSPS technical report No. 3/82.** Lemperle, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Sep 1982. Contract AC04-76DP00789. 66p. NTIS, PC A04/MF A01. Order Number DE83002230.

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The exact influences of varying sunshape distributions on the reflection mechanisms at the heliostat field and on the resulting flux distribution in the aperture plane of the receiver of a tower focus power plant are clarified. The practice of neglecting deviations from a standard sunshape distribution is questioned. Quantitative results establish the importance of sunshape influence as a considerable parameter. (LEW)

7153 (Juel-Spez—146, pp 104-105) **Thermal performance of heat absorbers.** Massmeyer, K.; Posorski, R. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

7154 **(MIT-EL—82-027) Solar energy conversion systems engineering and economic analysis radiative energy input/thermal electric output computation. Volume III.** Russo, G. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Sep 1982. Contract EX-76-A-01-2295-037. 261p. NTIS, PC A12/MF A01. Order Number DE83002467.

The direct energy flux analytical model, an analysis of the results, and a brief description of a non-steady state model of a thermal solar energy conversion system implemented on a code, SIRR2, as well as the coupling of CIRR2 which computes global solar flux on a collector and SIRR2 are presented. It is shown how the CIRR2 and, mainly, the SIRR2 codes may be used for a proper design of a solar collector system. (LEW)

7155 **(SAND—81-8186) Manufacture, distribution, and handling of nitrate salts for solar-thermal applications.** Fiorucci, L.C.; Goldstein, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1982. Contract AC04-76DP00789. 125p. NTIS, PC A06/MF A01. Order Number DE83003317.

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Based on their low cost and attractive physical properties, molten sodium/potassium nitrate salts have been shown to be one of the most cost-effective fluids for heat absorption and thermal energy storage in Solar Central Receiver (SCR) systems. Information relevant to the availability, transport, handling, and utilization of these salts for commercial-size SCR applications is provided. An overview is provided of existing manufacturing processes for natural and synthetic nitrates; the up-stream availability of raw materials; downstream existing and projected demand for these products in other sectors of the economy; and relevant handling and distribution technologies. Also reviewed are safety considerations and issues more directly related to the SCR facility, such as initial system charging, salt maintenance and regeneration, and disposal. Options for supply, surge storage, and initial charging are discussed for the 1 MWt to 300 MWe range of solar plant sizes.

7156 **(SAND—82-8184) Rotating field collector subsystem Phase I study and evaluation.** Jones, D.; Eibling, J.A. (Stilson (Alden E.) and Associates, Columbus, OH (USA)). Oct 1982. Contract AC04-76DP00789. 145p. NTIS, PC A07/MF A01. Order Number DE83003316.

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The rotating field collector system is an alternative concept in which all heliostats are mounted on a single large platform which rotates around a tower to track the azimuthal angle of the sun. Each heliostat is mounted to the platform with appropriate pivots, linkage, and controls to provide the additional positioning required to properly direct the solar radiation onto the receiver. The results are presented of the first phase of a study to investigate the technical and economic merits of a particular type of rotating field collector subsystem. The large pie-shaped platform would revolve over an array of support pedestals by means of a roller at the top of each pedestal. Several heliostats were built to demonstrate their construction features, and the operation of both flat and amphitheater rotating fields was studied. Work included an analysis of the concepts, development of modifications and additions to make the system comply with design criteria, and cost estimates to be used for comparison with other heliostat subsystems. Because of considerably high cost estimates, the focus of a large part of the study was directed toward developing lower cost designs of major components. (LEW)

7157 **(UCLA—12/1380) Preliminary safety analysis of conceptual hybrid, repowering, and retrofit applications of solar-thermal central-receiver technology.** Hurt, P.R.; Lindberg, R.G. (eds.). (California Univ., Los Angeles (USA). Lab. of Biomedical and Environmental Sciences). Sep 1982. Contract AC03-76SF00012. 117p. NTIS, PC A06/MF A01. Order Number DE83002807.

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A preliminary safety analysis was undertaken for fifteen conceptual designs of hybrid, repowering/retrofit applications of solar thermal central receiver technology. The approach was generic in nature and focused on safety concerns associated with the physical interfaces between solar thermal and fossil fuel technologies used in tandem to produce either electricity or industrial process heat. Simplified block diagrams were prepared to identify major interfaces, and a matrix analysis conducted for each design at both the system and subsystem levels. Health and safety concerns identified were compared with similar concerns and proposed mitigations presented for each of the conceptual designs by their developers. There was good agreement between lists. Health and safety concerns were primarily associated with fluid leaks including molten sodium, molten salt, hydrocarbons, and steam; fire and/or explosion; and increased maintenance and/or repair necessitated by certain failure modes. In general, the potential for health and safety programs was greater in the hybrid and repowering/retrofit designs than in either solar or fossil-fueled systems operated independently. This was due primarily to increased complexity of an integrated system and the opportunity for interactions between materials or components not used together in conventional systems. However, the preliminary state of the designs examined did not permit a quantitative ranking of potential hazards. This analysis, therefore, only identified potential hazards and did not determine their probability of occurrence. Some off-site problems were identified, but on balance off-site impacts were not judged to be any greater than for stand-alone systems. A primary benefit derived from combining solar and fossil technologies was reduction in off-site air pollution directly related to the kind and and amount of fossil fuel displaced by solar thermal energy.

7158 **Dynamic modelling and simulation of a solar power plant with water cooled solar receiver.** Maffezzoni, C.; Parigi, F. (ENEL, Milan, Italy). pp 621-628 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Conceiving and designing solar power plants based on thermodynamic cycle cannot be successfully carried out considering only the stationary operation of the plant but requires the aid of suitables mathematical models simulating the plant dynamic behavior. The features of two different models (with different accuracy and complexity) set up for the Eurelios solar power plant are described. In particular, the relevance of distributed transport phenomena to the solar receiver modelling is demonstrated. The most significant computational aspects, both with regard to the numerical methods and to the implementations means, are finally considered.

7159 **Feasibility study of the central receiver component of a solar power plant with gaseous working fluid. Pt. 1.** Becker, M. Koeln, Germany; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (1978). 87p. (In German).

General considerations concerning solar thermal power stations (tower concept) lead to the result that the heat transfer to the receiver is the most important parameter. Therefore, the report accentuates the analytical and numerical treatment of turbulent compressed air pipe flow with heat addition. The general view of receiver heat transfer and calculated examples of possible projects with gaseous medium relates to practice. Concerning the feasability the following can be stated: For a technical and economical optimization high heat flux densities (qsub(w) $>$ 100 kW/m^2) are recommended. With that only high pressures (p $>$ 20 bar) are compatible. Thus the closed cycle is indirectly favoured. Qualifying shall be hinted that in principle a receiver can be realized at low pressures (e.g. 4 bar) and low heat flux densities (qsub(w) = 10 to 40 kW/m^2). However, this receiver will be considerably larger, heavier, more expensive and thus less economic. This may seem to be balanced in other fields.

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

REFER ALSO TO CITATION(S) 7173

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 7155, 7177, 7181, 7184, 7187, 7771, 7827

7160 **(BFR-D—11-1981) Heat from solar energy and air with storage in water and ice. The Braemhult project in Boraas.** Abrahamsson, T.; Jonson, S.; Lagerkvist, K.O. (Swedish Council for Building Research, Stockholm). Mar 1981. 148p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82905453.

The heating system uses solar energy and the outdoor air as its primary heat source with water as the storage medium. The total solar collector area is 140 m^2, inclined 70° facing south. The solar energy is used first for preheating domestic hot water in the six houses, after which the remaining portion is transported to the

heat store, which has a volume of 25 m³. From the heat store heat is supplied to the floor heating system in each of the houses. Gross energy savings during one year have amounted to about 30%. For shorter periods 60% has been measured. The investment has been estimated to be about 5 SEK/kWh, with an annual cost of 0.75 SEK/kWh.

7161 **(DOE/CS/30284—T2) Solar for industry. Final report on conferences, Los Angeles, February 22, 1980 and San Francisco, March 21, 1980.** (California Solar Business Office, Sacramento (USA)). 15 Apr 1980. Contract FG03-79CS30284. 52p. NTIS, PC A04/MF A01. Order Number DE83003301.

Portions of document are illegible.

Two seminars on Solar for Industry were held, one in Los Angeles on February 22, 1980, and the other in San Francisco on March 21, 1980. Each conference is given an agenda, feedback, lists of attendees and invitees, and a published article. Also provided is a conference packet, including a questionnaire and original materials used. The conferences are evaluated and follow-up efforts are listed. (LEW)

7162 **(DOE/CS/30533—T1) Passively operated spool valve for drain-down freeze protection of thermosyphon water heaters. Final report.** (Sunspool Corp., Palo Alto, CA (USA)). Nov 1982. Contract FC02-80CS30533. 106p. NTIS (US Sales Only). Order Number DE83004110.

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Work to develop drain-down valving hardware for the freeze protection of passive (or thermosyphon) solar water heating systems is described. Efforts have focused on two district hydraulic draining schemes. Three types of valve actuators are explored: a PV-powered electrical version, a refrigerant operated version, and an ambient-temperature-sensing, cable-driven heat motor version. (MHR)

7163 **(DOE/CS/31500—T1) Ridgeline Racquet Club, Inc. Final technical report.** (Ridgeline Racquet Club, Inc., Orange, CA (USA)). [nd]. Contract FC03-77CS31500. 454p. NTIS (US Sales Only). Order Number DE83002207.

Mf only; illegibiity does not permit PC reproduction.

The installation and maintenance of the solar heating and cooling system of the Ridgeline Racquet Club are presented. The following are included: project photographs, site inspection, data collection, building codes, acceptance test plan, performance, construction problems, operations manual, preventive maintenance, and as-built drawings. (MHR)

7164 **(DTH-LV-MEDD—94) Solar heat-district heat system. Calculations of a central system with and without heat-storage.** Joergensen, L.S. (Danmarks Tekniske Hoejskole, Lyngby). Dec 1979. 26p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82900796.

A solar heating system, centrally situated and connected with a district heating plant can produce up to 400-450 KWh/year per m² of solar collector. If the total heat consumption is below 5000 KWh/year m² of solar collector, then the yield is higher with heat storage, over 5000 KWh/year m² the advantage is greater without heat storage. The performance of such system was computed for varying parameters of solar collectors and temperature.

7165 **(DTH-LV-R—80-6) Solar heating of a group of houses using seasonal heat storage.** Dytczak, M.A.; Nordgaard Hansen, P. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1980. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750319.

The present analyses and computations of the mode of operation of solar heating with seasonal storage to be used for settlements' heating leads to a series of general and detailed conclusions: Some urban parameters such as magnitude of settlement (group of houses) or the density of the buildings α, have great influence on the fundamental parameters of the thermal processes and consequently on the economy of the solar investment too. The most important conclusions are presented below; 1. The influence of the initial temperature theta(o) in the storage tank on all the parameters is small. 2) The correct selection of the magnitude of F, V is a fundamental matter for the last part of the work. There is always only one valid solution of F', V' within a small error of (ΔF ΔV) giving the satisfactory theta(T). 3) In the interesting range N=40-100 houses and α = 0.1-0.5 and for theta(o)=theta(start) = 25degC the magnitudes of F have been found about 82-100 m³/house and V=327-410 m³/house. 4) The increase of the parameters N and α have always effected the harmonious decrease of the magnitude of F and V. 5) The increase of theta(o) to 30degC leads to an important growth of both F and V. For large N and α this influence is, however, not so great as for small values of N and α. 6) The application of a solar heating system with seasonal heat storage for a group of houses greater than N > 100 leads to further decrease of F and V. The increase of the storage tank volume will be connected to the increase of singular investment costs (dollar/M³). 7) The possibilities of further improvement of the technical parameters as a function of F and V probably would be connected to; - the application of flat-plate collectors, - of a more complicated working schme for the system, and the optimization of the magnitude of the heat loss from the pipe lines.

7166 **(LA—9543-MS) Los Alamos passive test cell results for the 1981-82 winter.** McFarland, R.D.; Hedstrom, J.C.; Balcomb, J.D.; Moore, S.W. (Los Alamos National Lab., NM (USA)). Oct 1982. Contract W-7405-ENG-36. 54p. NTIS PCE04/MF A01. Order Number DE83002948.

Includes 2 sheets of 48x reduction microfiche.

This report covers Los Alamos test cell operation during the winter of 1981-82 including comparisons with the 1980-81 winter. Extensive data have been taken and computer-analyzed to determine performance parameters such as efficiency, solar savings fraction, and discomfort index. The data from different test cells are directly comparable because each has similar heating-load coefficient and collector area. Configurations include direct gain, unvented Trombe walls, water wall, phase-change wall, and sunspaces. Strategies for reducing heat loss include selective surfaces, two types of improved glazing systems, a heat pipe system, and convection suppression baffles. Significant differences in both auxiliary heat and comfort were observed among the various system types. The results are useful, not only for direct system comparisons, but also to provide data for validation of computer simulation programs. Availability of hourly data is described.

7167 **(NP—2750320) Solar heating system in Herfoelge. 1/2 year measurements.** Paulsen, O. (Teknologisk Inst., Taastrup (Denmark)). Jul 1980. 21p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750320.

As a part of the solar heating research program in Denmark a 100m² solar collector was used to heat water for domestic purposes. The collector is mounted on a roof of a one-storied residential building. Measurements and operation experience collected during the first 1 1/2 year of its performance will be used to improve next generation of solar water heaters.

7168 **(NP—2901931) Report of first national students' solar energy camp (20-30 June 1980).** Rao, U.K.; Prakash, B. (eds.). (Tata Energy Research Inst., Bombay (India)). 1981. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82901931.

After a brief overview of the Camp, reports on the students' individual projects are presented. The projects include solar drying, solar passive cooling systems, solar cooking, wind mills, solar distillation, rural cookstoves, and shallow solar ponds. Each student chose a project of interest and designed, fabricated, and tested the idea. (LEW)

7169 **(NP—3900455) Issues and options regarding information disclosure requirements for solar domestic hot-water systems.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). 18 Aug 1982. 20p. NTIS, PC A02/MF A01. Order Number DE83900455.

Portions of document are illegible.

Six major issues and numerous options are discussed relative to the disclosure requirements. The issues involve: the informational

elements to be included; tests for eligibility for tax credits, calculation methods in lieu of active system testing, site specific or climate zone performance disclosures, disclosure methods California Energy Commission should require, and methods available to enforce disclosure requirements.

7170 **(ORNL/CON—70) Performance and economics of residential solar space heating.** Zehr, F.J.; Vineyard, T.A.; Barnes, R.W.; O'Neal, D.L. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 224p. NTIS, PC A10/MF A01. Order Number DE83003187.

The performance and economics of residential solar space heating were studied for various locations in the contiguous United States. Common types of active and passive solar heating systems were analyzed with respect to an average-size, single-family house designed to meet or exceed the thermal requirements of the Department of Housing and Urban Development Minimum Property Standards (HUD-MPS). The solar systems were evaluated in seventeen cities to provide a broad range of climatic conditions. Active systems evaluated consist of air and liquid flat plate collectors with single- and double-glazing; passive systems include Trombe wall, water wall, direct gain, and sunspace systems. The active system solar heating performance was computed using the University of Wisconsin's F-CHART computer program. The Los Alamos Scientific Laboratory's Solar Load Ratio (SLR) method was employed to compute solar heating performance for the passive systems. Heating costs were computed with gas, oil, and electricity as backups and as conventional heating system fuels. Simple payback period, discounted payback period, and twenty year life cycle cost were computed for each system type, collector or glazing area, fuel, and city. The life cycle cost calculation for each system combination was made using a 2% discount rate and the Department of Energy's (DOE) suggested fuel escalation values. In addition, alternative life cycle costs were determined assuming federal and state income tax credits, financing charges, various discount rates, low and high cost extreme systems, and high fuel prices.

7171 **(SERI/TR—253-1356) Design approaches for solar industrial process-heat systems: nontracking and line-focus collector technologies.** Kutscher, C.F.; Davenport, R.L.; Dougherty, D.A.; Gee, R.C.; Masterson, P.M.; May, E.K. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 457p. NTIS, PC A20/MF A01. Order Number DE83003339.

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The design methodology for solar industrial process heat systems is described, and an overview is given of the use of solar energy in industry. A way to determine whether solar energy makes sense for a particular application is described. The basic system configurations used to supply hot water or steam are discussed, and computer-generated graphs are supplied that allow the user to select a collector type. Detailed energy calculations are provided, including the effects of thermal losses and storage. The selection of subsystem components is described, and control systems, installation and start-up details, economics, and safety and environmental issues are explained. (LEW)

7172 **Refrigerated storage of apples utilizing a hybrid solar system.** Best, R.; Pilatowsky, I. (Universidad Nacional Autonoma de Mexico, Mexico City). pp 465-473 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Fruit production in Mexico suffers from a deficiency of refrigerated storage facilities which, together with inadequate handling, is the main reason for the 40% loss in last year's fruit production. This article examines the problem of refrigerated storage as it affects the important apple crop. The author discusses the use of solar refrigeration in Mexico and proposes the use of a solid absorbant in the system. (RJC)

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 7114, 7156

7173 **(AD-A—114924/4) Assessment of some energy technologies associated with solar energy. Technical report.** Abarbanel, H.D.; Case, K.M.; Flatte, S.M.; Nierenberg, W.A.; Watson, K.M. (Stanford Research Inst., Arlington, VA (USA)). Oct 1981. 57p. NTIS, PC A04/MF A01.

Three alternative energy generation concepts are studied which employ solar energy in some part of the system. Discussed are: Salinity Gradient Solar Ponds, Osmotic Membrane Power Generation, and Thermochemical Storage and Transport.

7174 **(BMFT-FB-T—81-224) Test station for solar collectors in Brazil.** Anhalt, J.; Massmeyer, K.; Stein, H.J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 77p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750414.

R + D programmes for the utilization of solar energy are, besides the application of solar collectors for hot water production, aiming at systems operating above 100°C. In sunny regions, solar refrigeration and cooling, agricultural and industrial process heat, as well as thermodynamic engines are of special interest. The collectors and their operation under the climatic conditions at the place of a possible application are the key components of such solar systems. Based on the co-operation of the Institut fuer Kernphysik of the KFA Juelich and the Instituto de Fisica of the University of Sao Paulo/Brazil, a collector test station for testing of collector in the temperature range above 100°C was developed, installed and put into operation at the site of Atibaia, Sao Paulo/Brazil. Three collector types, installed and operated in a field size of about 20 m^2 each, provided useful methodical and technical information for comparable projects. The operational collector test station is open for scientific and technical investigations on solar collectors and systems which are of interest for Brazilian and German partner institutions.

7175 **(BMFT-FB-T—82-083) Development of large scale production methods for components of solar energy collection.** Hussmann, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750722.

The glass pane cover of flat plate solar collectors and its connection to the collector can be selected only, when all the mechanical and thermal stresses are known during operation. Loads from the environment as wind, snow, ice and hail are investigated. The loads due to operation as pressure rise related to temperature rise and thermal stresses are analyzed. The connection between glass panes and collector, cementing and fastening into a frame, are investigated too. The effective strength of glass panes - thermally strengthened and not strengthened - is described extensively. These methods, to calculate and predict the stresses in the cover plate and its connection to the collector are demonstrated by an example.

7176 **(BMFT-FB-T—82-139) Flat plate solar collectors.** Hussmann, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82751005.

Flat plate collectors of conventional design with high efficiency were developed. A special metal sheet fastened at the absorber leads to a construction, which is gas-tight and tolerates no flow conditions. Such collectors have a long service life. Especially the influence of the cover-system upon the efficiency was investigated by computer simulations. The typ of panes, the number and selective coatings on the panes or on the absorber were varied. Loads from the environment and loads due to operation as f.e. pressure rise related to temperature rise and thermal stresses were analyzed. This applies especially to cover systems and the cementing of the glass panes to the absorber. Prototypes were built and tested.

7177 **(DTH-LV-MEDD—109) Efficiency of solar collectors. Measured and calculated.** Svendsen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). May 1981. 145p. (In Danish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750322.

In the report flat-plate solar collectors and solar water heating systems are treated. Only the efficiency of the solar collectors and the output of the solar heating systems are dealt with. A detailed calculation model for solar collectors and a corresponding computer calculation program is described. By means of the program an analysis of the influence of the weather, the working and the installation conditions on the efficiency of typical solar collectors are performed. Various methods for testing and presentation of the efficiency of solar collectors are described and evaluated. The influence of the testing conditions on the results are examined by means of the above-mentioned calculation program. The testing results of a considerable number of solar collectors available on the market are described and analysed on the basis of the maximum efficiency and the heat loss coefficient. Solar heating systems used for domestic hot water are mentioned, and a simulation model for a chosen system design is made. The model is based on the results from testing the solar collector efficiency and the thermal properties of the heat storages. A simulation program based on the established model is described. The program, which can be run on a desk computer, normally uses a concentrated reference year of 36 days as a weather data bais. To the actual application there is a good accordance between the concentrated and the complete reference year.

7178 (Juel-Spez—146, pp 102-104) **Development of a simple test unit for comparative testing of solar collectors.** Sack, B.; Stein, H.J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

7179 (Juel-Spez—146, pp 106) **Round robin testing of evacuated tubular collectors.** Talarek, H.D. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

7180 (Juel-Spez—146, pp 107) **Pyranometry.** Talarek, H.D. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

7181 **(NP—2750321) Solar heating system at Juelsminde camping ground. 3 year measurements.** Paulsèn, O. (Teknologisk Inst., Tastrup (Denmark)). Aug 1980. 18p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750321.

A solar collector for water heating purposes has been installed on a camping ground. Three-year experience proves the 48m² solar absorber area to survive well, without essential weathering damage. Efficiency and operational parameters were in good agreement with calculated data.

7182 **Diffusion coefficient of trona in water.** Mehta, G.D.; Jain, S.C. (Sci Appl Inc, McLean, VA, USA). *Industrial and Engineering Chemistry Process Design and Development;* **21**: No. 3, 394-395(Jul 1982).

Laboratory experiments were conducted to measure the diffusion coefficient of trona in water. The diffusion coefficient of trona from saturated solution in water was measured to be 1.167 *10/sup -5/ cm/sup 2//s with a standard devition of 6.2% at 25/degree/C.30 10/sup 9/ refs.

7183 **Extraction of exergy from solar collectors under time-varying conditions.** Bejan, A. (Univ of Colo, Boulder, USA). *International Journal of Heat and Fluid Flow;* **3**: No. 2, 67-72(Jun 1982).

The trade-off between the storage and the immediate use of solar exergy is examined with the objective of maximizing the long-term exergy output from a solar collector installation. It is demonstrated that a trade-off exists, and that for maximum exergy output the collector and the collector-user interaction must conform to a well-defined pattern. It is also shown that the practice of operating collectors at constant temperature, regardless of time of day, is responsible for a sizeable and steady exergy loss. 10 refs.

7184 **Net energy analysis of residential solar ponds.** Brown, S.T.; Cambel, A.B. (George Washington Univ, Washington, DC, USA). *Energy (Oxford);* **7**: No. 5, 457-463(May 1982).

A net energy analysis (NEA) of three different residential solar pond scenarios is performed. The purpose of net energy analyis is to answer either or both of two questions: (a) how much energy input is required for a certain energy output? and/or (b) what is the payback period, i.e., how long will it take to recover the energy input in terms of net, useful energy? A single home, a complex of twenty homes and a community system with district heating are considered. The designs considered, A. Rabl-A. Nielsen and A. Krass-K. La Viale, are studied for locations in Columbus, Ohio and in Northampton, Massachusetts. The analysis reveals that economies of scale and design considerations influence the net energy ratio (NER). 21 refs.

7185 **Thin-film absorber for a solar collector.** Wilhelm, W.G. (to Dept. of Energy). US Patent Application 347,215. 9 Feb 1982. 35p. Contract AC02-76CH00016.

This invention pertains to energy absorbers for solar collectors, and more particularly to high performance thin film absorbers. The solar collectors comprising the absorber of this invention overcome several problems seen in current systems, such as excessive hardware, high cost and unreliability. In the preferred form, the apparatus features a substantially rigid planar frame with a thin film window bonded to one planar side of the frame. An absorber in accordance with the present invention is comprised of two thin film layers that are sealed perimetrically. In a preferred embodiment, thin film layers are formed from a metal/plastic laminate. The layers define a fluid-tight planar envelope of large surface area to volume through which a heat transfer fluid flows. The absorber is bonded to the other planar side of the frame. The thin film construction of the absorber assures substantially full envelope wetting and thus good efficiency. The window and absorber films stress the frame adding to the overall strength of the collector.

7186 **Short and long-term thermal storage in solar ponds.** Tabor, H. (Scientific Research Foundation, Jerusalem, Israel). pp 179-195 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

The combined collection and storage of a solar pond and the temperature rise in the pond are discussed, followed by short-term and long-term heat storage. For long-term storage, the radiation reaching the pond bottom and the extracted energy are treated as sine waves of one year period and out of phase. On the basis of that assumption, expressions are derived that describe the pond performance. (LEW)

1420 Heat Storage

REFER ALSO TO CITATION(S) 7164, 7165, 7173, 7675, 7866

7187 **(EUR—7701-EN) Development of a pebble-bed heat storage.** Pellerin, J.F. (Societe Bertin et Compagnie, 78 - Plaisir (France)). 1982. 28p. European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

Portions of document are illegible.

In a building heated by solar collectors, a storage system allows an efficient use of the heat collected during an off-peak period and avoidance of overheating. The research reported was aimed at a physical and numerical study of a pebble bed system associated with air solar collectors, and at the design, manufacture, and testing of a full scale pebble storage. Included is a brief cost study. (LEW)

7188 **Storing sunshine in salamis.** Marks, S.B. (Insolar Inc). *CHEMTECH;* **12**: No. 3, 182-186(Mar 1982).

Glauber's salt employed as a phase change material for the storage of solar energy quickly loses energy storage capacity with cycling, and additives are found to improve its performance. A thin film of laminated, metallized plastic is developed for packaging the material at a cost of about 10/cent/sub l/b. This plastic is compatible for use with a machine that is widely employed in stuffing sausage casings. 8 refs.

7189 **Solar heat storage: comparisons and goals.** Mustacchi, C. (Univ. of Rome, Italy); Cena V. pp 415-442 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

A number of options for storing solar heat are presented (water tanks, pile-up of rocks, soil, solar ponds, latent heat systems). The applicability of such options to hourly, daily, seasonal storage and the relevant economic pictures is discussed.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

7190 (DOE/ID/12079—71-Vol.1) **Geothermal direct heat program roundup technical conference proceedings.** Ruscetta, C.A. (ed.). (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jul 1982. 317p. (ESL—98-Vol.1; CONF-820491—Vol.1). NTIS, PC A14/MF A01. Order Number DE82019912.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Portions of document are illegible.

Separate abstracts were prepared for the seventeen papers in this proceedings.

7191 (DOE/ID/12079—71-Vol.1, pp 76-87) **Characterization of the geothermal resources of southeastern Idaho.** Sherman, F.B. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Much of southeastern Idaho displays the complex geology of the overthrust belt and the Basin and Range geomorphic province. Thrust and normal faults are important in controlling groundwater movement, however, the thrust faults do not appear to create layers of either significantly higher or lower permeability. The hottest thermal discharges in the region are associated with deep normal faults. The hottest waters in the area have Na and Cl as the dominant ions, while lower temperature hydrothermal waters are characteristically Ca/Mg and HCO_3 waters. Limited data from deep drill holes in the area do not indicate a high geothermal gradient.

7192 (DOE/ID/12079—71-Vol.1, pp 141-157) **Three years of geothermal research in Nebraska.** Gosnold, W.D. Jr. (Univ. of Nebraska, Omaha); Eversoll, D.A.; Carlson, M.P. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

The results of the first three years of geothermal research in Nebraska are encouraging in their promise for the discovery and development of low-temperature geothermal resources and from the standpoint of scientific value. A sucessful method for geothermal exploration has been developed and extensive low-temperature geothermal deposits have been discovered in Cretaceous age rocks that underlie a total area of about 107,000 km^2 and contain about 1000 x 10^{18} J of stored energy. Heat flow data indicate zones of large-scale, slow flow in deep aquifers. This discovery of deep aquifer flow patterns by surface heat flow has important implications for both geothermics and hydrology. The heat flow data also indicate some areas of high heat flow that may be due to high radioactive heat generation in the Precambrian crystalline rocks. One of the original tasks of the program is evaluation of the bottom hole temperatures (BHT) for more than 14,000 oil and gas exploration wells. The preliminary interpretations of the BHT data are that the gradient patterns indicated by the BHT data do not coincide with the known thermal regime, and that the validity of the data are questionable. The geothermal resource map of Nebraska has been completed.

7193 (DOE/ID/12079—71-Vol.1, pp 158-170) **Program accomplishments and future prospects for low-temperature geothermal resource assessment in New Mexico.** Icerman, L. (New Mexico State Univ. Energy Inst., Las Cruces). Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

An important component of the State-coupled program has been basic studies in specific regions of New Mexico, including areas adjacent to the cities of Albuquerque, Las Cruces, Socorro, and Truth or Consequences. Considerable geological, hydrological, electrical resistivity, gravity, magnetic, seismic, water analysis, and subsurface temperature data have been compiled and analyzed for these locations. During the four-year research program, a total of 25 tasks have been undertaken. Eleven of these tasks were focused toward collecting and compiling statewide data, six were regional studies covering more than one county, and eight were research projects directed primarily toward data collection near specific cities or known resource areas. Two of these latter studies contributed significantly to the confirmation of the Las Alturas geothermal anomaly east of Las Cruces. A brief summary of the program accomplishments by task is presented. The resource assessment programs in New Mexico have been very successful in (1) delineating low-temperature geothermal resources throughout New Mexico on statewide, regional, and area-specific scales; (2) developing a strong community of in-state geothermal energy research and development professionals and practitioners; and (3) elevating the level of awareness of geothermal energy potential among commerce, industry, and the general public. Future prospects for the state are presented.

7194 (DOE/ID/12079—71-Vol.1, pp 176-186) **Evaluation of the hydrothermal resources of North Dakota, the final phase.** Harris, K.L.; Howell, F.L.; Wartman, B.L.; Anderson, S.B. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Data relative to aquifer locations, temperature, and water quality for Pleistocene aquifers and preliminary interpretations of this data are presented in map form. The maps present sand and gravel occurence, total dissolved solids, shallow geothermal gradients, and location of wells. (MJF)

7195 (DOE/ID/12079—71-Vol.1, pp 274-291) **Low temperature geothermal resources of eastern Washington.** Korosec, M.A.; Phillips, W.M.; Schuster, J.E. (Geology and Earth Resources, Olympia, WA). Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

The well information data collected during 1980 and 1981, the approaches taken toward manipulation of this data, and the updated picture of the nature and extant of geothermal resources within the Columbia Basin are summarized. Fair quality gradients range from 25 to 90°C/Km, but the average falls between 35 to 45°C/Km. Areas where the gradient is in excess of 45°C/Km are discussed. (MJF)

7196 (NYSERDA—81-14) **Geology, drill holes, and geothermal energy potential of the basal Cambrian rock units of the Appalachian Basin of New York State.** Pferd, J.W. (TAL Research and Development, New York (USA)). Jun 1981. 79p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223.

Portions of document are illegible.

The published geologic and geophysical records plus data gathered from deep wells during hydrocarbon exploration were inventoried, discussed and summarized to evaluate hydro-geothermal energy potential in the western counties of New York, south of the 42° latitude. An assessment is provided of local geothermal energy potential based on these data. The assessed potential is a function of the geothermal gradient, the depth of porous Cambrian age sedimentary units and a variety of features thought to be related to deep fracturing and hence enhanced porosity and permeability. The completion history of a selected set of plugged and abandoned deep wells was examined to determine the feasibility and advisability of re-entering these holes for geothermal development. All wells

showed extensive cement plugging and uncertain materials introduced for bridging. It was recommended that no attempt be made to re-enter these wells. The hydro-geothermal energy potential in Western New York State is largely comparable to that of other regions possessing porous/permeable units of sedimentary rock at sufficient depth to contain formation waters of useful temperatures (>140°F). A comparison of geothermal reservoirs in New York to similar sites now under development in Canada and France has revealed that potential resources in New York State are slightly hotter, though somewhat thicker and less permeable with significantly higher proportions of dissolved constituents.

1502 Geology And Hydrology Of Geothermal Systems

7197 (DOE/ID/12079—71-Vol.1, pp 205-227) **Implications of volcano-tectonic patterns in the Oregon cascades for geothermal exploration.** Priest, G.R. (Oregon Dept. of Geology and Mineral Industries, Portland); Woller, N.M.; Black, G.L.; Evans, S.H. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Basin and Range and subduction-related processes may have combined to produce voluminous mafic volcanism and very high heat flow in the central Oregon High Cascades during the last 9 m.y. This high rate of volcanism and heat flow prevails south of the Clackamas River right lateral wrench fault zone. South of this zone the volume of mafic volcanic rocks less than 9 m.y. old increases abruptly and regional heat flow increases by at least 20 mW/m^2. A similar, but larger, increase in volcanism and heat flow characterizes the transition from the Blue Mountain block to the Basin and Range Province at the Brothers right lateral wrench fault zone. A significant amount of the 0 to 9 m.y.B.P. mafic volcanic rock in the Cascades is basalt, with one or all of the following attributes of contemporaneous basalts of the Brothers Fault Zone-Basin and Range province: (1) anomalously high alkali and iron content relative to normal calc-alkaline rocks; (2) diktytaxitic texture with titaniferous groundmass clinopyroxene. This suggests a common petrogenesis for these basalts, perhaps from partial melting related to Basin and Range spreading. Potential operation of two partial melting mechanisms in the Oregon High Cascades may cause a high rate of magmatic heat transferral from mantle regions relative to transferral in the Basin and Range. This means that the High Cascades probably has the highest geothermal potential of any province in Oregon, especially where intercepted by youthful faults. North-south faults which bound a large area of Pliocene to Pleistocene subsidence along the High Cascade axis are good exploration targets. Silicic volcanism at the Brothers Fault zone intersection makes this the best exploration target in Oregon.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 7190, 7196

7198 **(DOE/ET/27196—T8) Imperial County geothermal development. Summary report, 1979-1982.** (El Centro, City of, CA (USA). Dept. of Public Works). Oct 1982. Contract FC03-79ET27196. 29p. NTIS, PC A03/MF A01. Order Number DE83002779.

Portions of document are illegible.

The progress of geothermal development during the past three years, county activities in support of geothermal development, and current challenges and future needs of the geothermal industry and the county are summarized. Exploration activities have resulted in the identification and definition of three additional Known Geothermal Resource Areas (KGRAs) during the grant period: the Westmorland KGRA, the East Brawley KGRA, both in 1980, and the South Brawley KGRA in 1982. Exploration is continuing in other areas of the county as well. Three 10 megawatt power plants have begun operations during the grant period: the Magma East Mesa 10 Megawatt Binary Power Plant, the Union/Southern California Edison 10 Megawatt Flash Power Plant in Brawley, both beginning operations in 1980, and the Union/Southern California Edison 10 Megawatt Flash Power Plant at the Salton Sea, initiating operations in 1982. Three commercial power plants are scheduled to begin construction during late 1982 or early 1983. Groundbreaking for the Heber Binary Project is scheduled for November 1982. Site work has already begun for the Heber Flash Power Plant. The Magma 28 megawatt power plant at the Salton Sea is to begin construction in early 1983. Two commercial power plants are in planning stages. (MHR)

7199 (DOE/ID/12079—71-Vol.1, pp 8-32) **Thermal fluid geochemistry of the Makushin and Akutan geothermal prospects.** Motyka, R.J. (Geological and Geophysical Surveys, College, AK). Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

The Makushin and Akutan geothermal prospects occur in the eastern Aleutian island arc, on northern Unalaska Island and on Akutan Island, respectively. Surface manifestations of the geothermal resources in both localities consists of solfatara fields and thermal springs. Distinct differences in chemistries of thermal springs and fumaroles associated with the two geothermal prospects reflect differences in the type of subsurface reservoirs underlying the two regions. Thermal springs at Makushin are typically near-neutral in pH, have very low chloride levels (< 10 ppM), and are comparatively rich in Mg, Ca, SO_4, HCO_3, and SiO_2. Similarities in cation and isotopic compositions of Makushin thermal springs compared to local surface streams indicate the thermal waters are locally derived meteoric waters infiltrating to relatively shallow depths where they are heated by steam and gases rising from at least a shallow vapor-dominated zone. Predominate fumarolic gases are CO_2, N_2, and sulfur gases. Thermal springs located in Akutan Hot Springs Bay Valley have very low Mg (< 2 ppM), are SiO_2-rich, and are moderately concentrated in Na-Cl, a chemistry typically associated with hot-water hydrothermal systems. B/Cl ratios indicate the several sets of springs are derived from a common parent hot-water reservoir. Application of silica, cation, and sulfate-water oxygen-isotope geothermometry gives a range of 160 to 190°C for the parent reservoir.

7200 (DOE/ID/12079—71-Vol.1, pp 33-61) **Exploration for geothermal energy in Arizona basin and range.** Witcher, J.C. (Univ. of Arizona, Tucson). Jul 1982. NTIS, PC A14/MF A01. Contract FC07-79ID12009.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

A summary of the results and interpretations of heat flow and geochemistry studies in the Safford Basin, Arizona, is presented. Numerous artesian wells discharge thermal water at 30 to 50°C. The Artesia anomaly is characterized by high soil mercury, ranging from 225 ppb to 380 ppb, and high apparent heat flow, ranging from 1.35 $\mu cal/cm^2sec$ at a depth of 65 to 95 ft to 5.25 $\mu cal/cm^2sec$ at a depth of 70 to 130 ft. It is concluded that the factors point toward a hydrothermal convention system possibly controlled by basement structure. (MJF)

7201 (DOE/ID/12079—71-Vol.1, pp 64-75) **Helium and ground temperature surveys at Steamboat Springs, Colorado.** McCarthy, K.P.; Been, J.; Reimer, G.M.; Bowles, C.G.; Murrey, D.G. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

As demonstrated in Steamboat Springs, Colorado, helium and shallow temperature surveys are quick, inexpensive geothermal exploration methods that can be used together with excellent results. Steamboat Springs, in northwestern Colorado, lies primarily upon terrace gravels and alluvium with the major structure being a north-trending normal fault passing through the western portion of the city. Work by Christopherson (1979) indicates that the Steamboat warm springs are not laterally connected at shallow depth with Routt Hot Springs, 6 km to the north, although both resource areas are fault controlled. A shallow temperature survey was conducted in the city to determine the usefulness of this method in a low temperature resource area. Several extraneous factors influencing shallow temperature measurements were dealt with by field technique or subsequent analysis. A helium survey was conducted to compare with temperature results. Sixty-two soil helium samples were taken, using an interval of .1 to .2 Km, twice the density of the 18 temperature probe stations. A mobile spectrometer allowed

immediate analysis of helium samples. A direct correlation of temperature to helium value at each site is not valid due to the high solubility of this gas. The contoured data from each method does correlate well and indicates that two faults control the resource in Steamboat Springs. Although these surveys should always be used to supplement other data, their utility in this study was readily apparent.

7202 (DOE/ID/12079—71-Vol.1, pp 88-121) **Relationships between geology and geothermal gradients in Kansas.** Stavnes, S.A.; Steeples, D.W. (Kansas Geological Survey, Lawrence). Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Bottom hole temperature values from existing oil and gas wells and thermal logging data from geothermal wells are used to determine the factors responsible for geographic variation in the subsurface temperature distribution in Kansas. Geothermal gradient data range from 25°C/km to 55°C/km in the upper 300 m. The geologic factors proposed to explain this variation are: (1) topography of the crystalline basement surface; (2) variation in rates of heat production in the crystalline basement; (3) variation in thermal conductivity in the sedimentary section; and (4) possible convection upward and eastward from the Denver-Julesberg Basin. (MJF)

7203 (DOE/ID/12079—71-Vol.1, pp 122-140) **Deer Lodge Valley investigations, western Montana.** Wideman, C.J.; Sonderegger, J.; Crase, E.; Peterson, J. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

A review of the geothermal investigations conducted in the Deer Lodge Valley of Western Montana is briefly presented. Maps of the generalized geology and Bouguer gravity and graphs of selected geothermal gradients and resistivity sounding profiles are presented. (MJF)

7204 (DOE/ID/12079—71-Vol.1, pp 171-175) **Update on geothermal exploration and drilling in the capital district of New York.** Sneeringer, M.R.; Dunn, J.R. (Dunn Geoscience Corp., Latham, NY). Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Exploration in the Capital District area of New York has provided both direct and indirect evidence of anomalous geothermal heat. Previous work has included water sampling programs for geochemical analyses, thermal gradient measurements in abandoned water wells, a micro-seismic monitoring program, and a small scale gravity survey. The current exploration program includes an expanded water sampling program for silica analyses, designed to improve coverage for a regional evaluation and to check previous work. Additional work is being done with major and trace element data for water samples from last year's program in an effort to unravel the complex mixing taking place between several water types, and to reevaluate the spatial relationships of compositional variations. The thermal gradient measurement program has also continued, both making new measurements and monitoring certain wells. The New York State Geological Survey is continuing to operate the seismic monitoring network established last year, and are reevaluating data previously collected. In addition, the major effort of this program is drilling several shallow (400 to 500 feet) wells and one deep (2000 feet) well for thermal gradient measurements. Results of the silica sampling program and drilling to date are discussed.

7205 (DOE/ID/12079—71-Vol.1, pp 187-204) **Geothermal resource assessment in Oklahoma.** Harrison, W.E. (Oklahoma Geological Survey, Norman); Luza, K.V.; Prater, M.L.; Cheung, P.K. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

The procedures and methods used to develop a geothermal gradient map of Oklahoma are discussed. Two areas, Haskell and Pittsburg Counties, in the Arkoma Basin, are discussed in detail. Three sandstone units, the Spiro, Cromwell, and Hartshorne were selected as potential low-temperature geothermal water sources. The average temperature ranged from 103°F at Hartshorne to 158°F at Cromwell. (MJF)

7206 (DOE/ID/12079—71-Vol.1, pp 228-239) **Geothermal anomalies in central Texas - Darcy's Law versus the heat-flow equation.** Woodruff, C.M. Jr. (Univ. of Texas, Austin). Jul 1982. NTIS, PC A14/MF A01. Contract AS07-79ID12057.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Data on geothermal anomalies within the Edwards Limestone of Central Texas is presented, and the premises underlying both the definition and the assessment of low-temperature geothermal resources are critiqued. The focus is on stratigraphic aquifers that compose basinal hydrodynamic systems characteristic of many of the Plain Sthates. It is concluded that in most near-surface areas ground-water flow, not heat flow, probably determines local thermal regimes; that the presumed heat flow anomaly has a hydrodynamic origin rather than a conductive (deep crystal) source; and that the data indicate that the heat-flow equation should be applied guardedly in assessing geothermal resource potential at depths shallower than 4000 ft in basinal areas of the midcontinents. (MJF)

7207 (DOE/ID/12079—71-Vol.1, pp 240-272) **Geothermal reconnaissance of a portion of the Escalante Valley, Utah.** Klauk, R.H.; Foreman, M.B.; Gourley, C. Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Geothermal exploration of the Escalante Valley region of Utah is discussed. A possible low to moderate temperature geothermal resource was found to the northwest of Zane. At this location, the measured water temperature ranged from 20 to 28°C with total dissolved solids ranging from 1556 to 1730 ppM; the Na-K-Ca geothermometer temperatures ranged from 91 to 97°C. The highest gradient calculated was 138°C/km. (MJF)

7208 (DOE/ID/12079—71-Vol.1, pp 292-312) **Heat flow studies in Wyoming: 1979 to 1981.** Heasler, H.P.; Decker, E.R.; Buelow, K.L. (Univ. of Wyoming, Laramie). Jul 1982. NTIS, PC A14/MF A01.

From Geothermal energy exploration and resource assessment technical conference; Salt Lake City, UT, USA (5 Apr 1982).

Heat flow values and updated maps of flux in Wyoming, northern Colorado, and southern Montana are presented. It is concluded that most of the heat flow values in the Wyoming Basin-Southern Rocky Mountains region in Southern Wyoming are low or normal, excluding the Saratoga Valley; that the regional flux in the Owl Creek Mountains area is above normal; and that the Meadow Creek Basin area is in a zone of high flux. (MJF)

7209 **(HN—00020-1098) Colado geothermal resource assessment: shallow-hole temperature survey; intermediate-depth holes IGH No. 1 and No. 2; depth test hole 44X-10. Final report.** Jones, N.O. (Holmes and Narver, Inc., Las Vegas, NV (USA). Energy Support Div.; Getty Oil Co., Bakersfield, CA (USA)). Sep 1982. Contract AC08-76NV00020;AC08-79ET27008. 70p. D. Order Number DE83002898.

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The Getty Oil Company began the field work on a government cost-sharing venture to assess the geothermal potential in the Colado area of Pershing County, Nevada. Eighteen shallow (500-foot) temperature gradient holes, two intermediate (1500-foot) temperature gradient holes and one deep (8000-foot) exploratory well were drilled. All field work was completed in May 1981. Maximum temperature achieved was 282°F at 7064 feet. No fluid reservoir was encountered with this hole.

7210 **Fluid-mineral equilibria in a hydrothermal system, Roosevelt Hot Springs, Utah.** Capuano, R.M.; Cole, D.R. (Univ. of Utah Research Inst., Salt Lake City). *Geochimica et Cosmochimica Acta;* **46**: No. 8, 1353-1364(Aug 1982). Contract AC07-79ID12079.

The composition of the deep reservoir fluid was estimated from surface well samples, allowing for steam loss, gas release, mineral precipitation and ground-water mixing in the well bore. This deep fluid is sodium chloride in character, with approximately 9700 ppm dissolved solids, a pH of 6.0, and gas partial pressures of O_2 ranging from 10^{-32} to 10^{-35} atm, CO_2 of 11 atm, H_2S of 0.020 atm and CH_4 of 0.001 atm. Comparison of the alteration mineralogy from producing and nonproducing wells allowed delineation of an alteration pattern characteristic of the reservoir rock. Theoretical alteration mineral assemblages in equilibrium with the deep reservoir fluid, between 150° and 300°C, in the system Na_2O-K_2O-CaO-MgO-FeO-Fe_2O_3-Al_2O_3-H_4SiO_4-H_2O-H_2S-CO_2-HCl, were calculated. Minerals theoretically in equilibrium with the calculated reservoir fluid at >240°C include sericite, K-feldspar, quartz, chalcedony, hematite, magnetite and pyrite. This assemblage corresponds with observed higher-temperature (>210°C) alteration assemblage in the deeper parts of the producing wells. The presence of montmorillonite and mixed-layer clays with the above assemblage observed at temperatures <210°C corresponds with minerals predicted to be in equilibrium with the fluid below 240°C. Alteration minerals present in the reservoir rock that do not exhibit equilibrium with respect to the reservoir fluid include epidote, anhydrite, calcite and chlorite. These may be products of an earlier hydrothermal event, or processes such as boiling and mixing, or a result of errors in the equilibrium calculations as a result of inadequate thermochemical data.

7211 **Directional drilling equipment and techniques for deep, hot granite wells.** Brittenham, T.L.; Neudecker, J.W.; Rowley, J.C.; Williams, R.E. (Grace, Shursen, Moore and Assoc). *Journal of Petroleum Technology;* **34**: No. 7, 1421-1430(Jul 1982).

Conventional directional drilling technology has been extended and modified to drill the first well of a subsurface geothermal energy extraction system at the Fenton Hill, NM, hot dry rock (HDR) experimental site. Ambitious borehole geometries, extremely hard and abrasive granite rock, and high formation temperatures combined to provide a challenging environment for directional drilling tools and instrumentation. 17 refs.

7212 **(DOE/ET/27204—T1-Vol.2-App.Sect.5) Assessment of the geothermal resources of Kansas.** (Kansas Univ., Lawrence (USA)). Jun 1982. Contract AS07-79ET27204. 65p. NTIS (US Sales Only). Order Number DE83003216.

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This volume contains thermal data for some deep wells in Kansas. (MHR)

7213 **(DOE/ET/27204—T1-Vol.2-App.Sect.4) Assessment of the geothermal resources of Kansas.** (Kansas Univ., Lawrence (USA)). Jun 1982. Contract AS07-79ET27204. 68p. NTIS (US Sales Only). Order Number DE83003215.

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This volume contains BHT correction factor analysis, repeatability study of control well, and an analysis of thermal logging method, including thermal data for some deep wells in Kansas. (MHR)

7214 **(DOE/ET/27207—T1-Vol.2-App.Sect.3) Assessment of the geothermal resources of Kansas.** (Kansas Univ., Lawrence (USA)). Jun 1982. Contract AS07-79ET27204. 90p. NTIS (US Sales Only). Order Number DE83003222.

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This volume contains regression analyses of thermal gradients computed for 1980 and 1981 with respect to unconsolidated sediments and with respect to water table. (MHR)

7215 **(DOE/ET/27204—T1-Vol.2-App.Sect.2) Assessment of the geothermal resources of Kansas.** (Kansas Univ., Lawrence (USA)). Jun 1982. Contract AS07-79ET27204. 55p. NTIS (US Sales Only). Order Number DE83003221.

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This volume contains regression analyses of thermal logging data, usable and non-usable, for 1980 and 1981. (MHR)

7216 **Review of well logging in the Basin and Range Known Geothermal Resource Areas.** Glenn, W.E.; Ross, H.P.; Atwood, J.W. (Univ of Utah, Salt Lake City, USA). *Journal of Petroleum Technology;* **34**: No. 5, 1104-1118(May 1982).

A discussion is presented of applications and interpretations of well logs to Basin and Range Province geothermal exploration and development. Problems experienced in use of conventional oilfield tools and techniques are reviewed, and methods to circumvent these problems are illustrated. Particular examples focus on log responses and matrix effects in complex lithologies. 36 refs.

7217 **(DOE/ET/27204—T1-Vol.1-Sect.3) Regional interpretation of Kansas aeromagnetic data.** Yarger, H.L. (Kansas Geological Survey, Lawrence (USA)). 1982. Contract AS07-79ET27204. 104p. NTIS, PC A06/MF A01. Order Number DE83003219.

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The aeromagnetic mapping techniques used in a regional aeromagnetic survey of the state are documented and a qualitative regional interpretation of the magnetic basement is presented. Geothermal gradients measured and data from oil well records indicate that geothermal resources in Kansas are of a low-grade nature. However, considerable variation in the gradient is noted statewide within the upper 500 meters of the sedimentary section; this suggests the feasibility of using groundwater for space heating by means of heat pumps.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 7198

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 6955, 7211

7218 **Wellbore effects in the analysis of two-phase geothermal well tests.** Miller, C.W.; Benson, S.M.; O'Sullivan, M.J.; Pruess, K. (Lawrence Berkeley Lab, CA, USA). *SPEJ, Society of Petroleum Engineers Journal;* **22**: No. 3, 309-320(Jun 1982).

A method of designing and analyzing pressure transient well tests of two-phase (steam/water) reservoirs is given. Wellbore storage is taken into account, and the duration of it is estimated. It is shown that the wellbore flow can dominate the downhole pressure signal completely such that large h changes in the downhole pressure that might be expected because of changes in kinematic mobility are not seen. Changes in the flowing enthalpy from the reservoir can interact with the wellbore flow so that a temporary plateau in the downhole transient curve is measured. Application of graphical and nongraphical methods to determine reservoir parameters from drawdown tests is demonstrated. 22 refs.

7219 **Geothermal steam well testing: state of the art.** Economides, M.J.; Ogbe, D.O.; Miller, F.G.; Ramey, H.J. Jr. (Univ of Alaska, Fairbanks, USA). *Journal of Petroleum Technology;* **34**: No. 5, 976-988(May 1982).

This study presents a comprehensive state of the art in pressure transient analysis of geothermal steam wells. The techniques encompass drawdown and conventional buildup as well as the newer fractured parallelepiped models. The latter have been used successfully in the analysis of field data from Larderello, Italy, and The Geysers in California. Field examples follow the presentation of each technique. 43 refs.

7220 **Model studies of the depletion of two-phase geothermal reservoirs.** Pruess, K.; Bodvarsson, G.S.; Schroeder, R.C.; Witherspoon, P.A. (Lawrence Berkeley Lab, CA, USA). *SPEJ, Society of Petroleum Engineers Journal;* **22**: No. 2, 280-290(Apr 1982).

This study investigates, for a variety of idealized model reservoirs, the phenomena occuring during production from and injection into two-phase geothermal systems. Using numerical simulation

and an analytically solvable lumped-parameter reservoir model, we study systems with uniform initial conditions as well as systems with steam/water interfaces. The main objective is to identify the signature of reservoir characteristics in pressure decline curves for different production and injection strategies. 18 refs.

7221 **Health and safety implications of alternative energy technologies. I. Geothermal and biomass.** Watson, A.P.; Etnier, E.L. (Oak Ridge National Lab., TN). *Environmental Management;* 5: No. 4, 313-327(1981). Contract W-7405-ENG-26.

An evaluation of potential occupational and public health aspects of geopressure, hydrothermal, hot dry rock, silviculture, crop and animal residues, fermentable plant products, municipal waste, and plantation energy technologies has been performed. Occupational exposure to hydrogen sulfide gas occurs near all geothermal sites and wherever organic matter decomposes anaerobically. Respiratory damage has occurred to laborers in geothermal fields, while farm workers have been fatally overcome when employed near agitating liquid manure systems. However, the most frequent and severe of reported injuries to geothermal workers is dermal exposure to caustic sludges produced by H_2S abatement systems. Principal health and safety considerations of biomass pathways are directly related to the diffuse nature of solar energy fixation by photosynthesis and subsequent transfer to animal food chains. Since the potential fuel is in an unconcentrated form, cultivation, harvest, and transport are necessarily labor-intensive. Thus, a significant potential for occupational injuries and fatalities exists. Of all biomass systems evaluated, direct burning of solid fuels presents the greatest public health risk. Data are presented to characterize the population at risk and the frequency and severity of injuries. (JMT)

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 7212

16 TIDAL POWER

1607 Tidal Power Plants

7222 **Energy accounting of River Severn tidal power schemes.** Roberts, F. *Applied Energy;* 11: No. 3, 197-213(Jul 1982).

An energy accounting exercise has been carried out, using data currently available from the main contractors, for three alternative Severn Tidal Power schemes - Line 5s Lavernock to Brean Down; Line 5s plus second stage bund enclosing Bridgewater Bay; and Line 2.5, Minehead to Aberthaw. The energy ratios, GJ/sub e//GJ/sub t/, obtained for these three schemes fall respectively within the following bands - 12:1 to 16:1, 10:1 to 14:1, and 12:1 to 16:1. Solely on the basis of energy accounting, and using the best data available at the time of the exercise, the straightforward schemes based on Lines 5s and 2.5 look equally attractive, and would be preferred to Line 5s plus second stage bund. 6 refs.

17 WIND ENERGY

1701 Availability (climatology)

7223 **(BMFT-FB-T—82-106) Simple anemometer for wind-classification.** Friedrichs, H.J.; Lorenzen, B.; Haug, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1982. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750958.

Status: the project has been finished since January 1981. The objective was to develop a simple independent system that allows automatic long duration data colecting of wind speed data being significant for possible locations for a small wind energy converter. A modified anemometer (impulse-transmitter) and an electronic device-unit had been developed to classify the occuring wind speeds and collect their values by setting devices in certain intervals. Tests in the laboratory plus climatic chamber-, windtunnel- and out-door-tests gave satisfying results. Typical applications for the system would be any kind of location research for small wind energy converters especially in developing countries.

7224 **(NP—3900249) Wind situation at Helgoland with special emphasis of wind power utilization.** Duensing, G.; Zoellner, R. (Deutscher Wetterdienst - Seewetteramt, Hamburg (Germany, F.R.)). 1979. 64p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83900249.

The Federal Republic of Germany's Ministry of Research and Technology authorized the German Weather Service to make an expertise on the wind situation at Helgoland. The usual climatological elements are presented as mean values and their annual variations. Special emphasis is laid on the wind. The annual variations of the monthly mean wind speeds, the daily variation of the 10-min-mean wind speeds, and their directional distribution are discussed. Some wind speeds are given for greater heights up to 150 m. They were extrapolated from the mean wind speeds at the height of the anemometers. To allow for a more detailed estimate of wind power utilization possibilities in the Helgoland area, the mean annual duration of the exceeding of certain limits of wind speed, and the absolute frequencies of the length of the time intervals, during which the wind speed exceeds the aforementioned limits without any interruption, are presented. This study is based mainly upon data from 1972 to 1976. For this interval continuous time series of 10-min-mean wind speed evaluation were available for some German light vessels.

7225 **Development and evaluation of wind forecasts for wind energy applications.** Wegley, H.L. (Pacific Northwest Lab., Richland, WA). pp 120-127 of 9th conference on weather forecasting and analysis. Boston, MA; American Meteorological Society (1982).

From 9. conference on weather forecasting and analysis; Seattle, WA, USA (28 Jun 1982).

This paper describes the development of 24-hour wind speed forecasts for wind energy applications using both MOS and a semi-objective approach. Results of detailed analysis of the MOS forecasts and preliminary varification of the semi-objective (S-O) forecasts are presented. The two sets of forecasts are compared and the value of such forecasts to electrical utilities is estimated.

1704 Economics

REFER ALSO TO CITATION(S) 8360

7226 **(SERI/TR—98282-2) Production costing of an advanced/innovative wind energy concept (AIWEC): extension of the SAMICS methodology.** Kleine, B.; Callahan, J.C. (CACI, Inc. - Federal, San Diego, CA (USA)). Nov 1982. Contract AC02-77CH00178. 138p. NTIS (US Sales Only). Order Number DE83003085.

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The Standard Assembly-line Manufacturing Industry Costing Standards (SAMICS) were designed as a tool for estimating the price of a manufactured product based on an assembly-line production facility. The cost of products such as the McDonnell Douglass 40-kW Giromill, which cannot be manufactured on an assembly line in small quantities, could not be analyzed using the standard SAMICS methodology. To analyze the cost of such products using SAMICS, it was necessary to adapt the standard methodology for application to a job shop configuration. The resulting methodology extension is reported.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 7150, 7771

7227 (BMFT-FB-T—82-072) Test program for wind energy conversion system GROWIAN. Koerber, F. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750697.

A test program for the German large scale wind energy converter GROWIAN is planned. Special emphasis was laid on the action of wind and the reaction of the machine in the field of dynamics, load and control. For wind measurement a grid arrangement of anemometers was designed covering entirely the rotor area in 25 m steps. Rated power and efficiency of power conversion will be measured with regard to rotor aerodynamics and operation conditions. The behaviour of the GROWIAN asynchronous generator on the power supply line will be evaluated. Another essential item is the analysis on environmental impact like sound and TV interference. A proposal for measurement procedures and data processing is made.

7228 (BMFT-FB-T—82-086) Development of a 5,5 m diameter vertical axis wind turbine (phase 3). Dekitsch, A.; Etzler, C.C.; Fritzsche, A.; Lorch, G.; Mueller, W.; Rogalla, K.; Schmelzle, J.; Schuhwerk, W.; Vollan, A.; Welte, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750730.

In continuation of the preceding project - Development of a 5.5 m-Diameter Vertical Axis Wind Turbine (Phase II), consisting in layout, build up and wind tunnel testing - the wind turbine equipment was completed for a one year field test supplying to a small power grid under optimum conditions of operation independent of different wind speeds. Two Savonius-rotors, 2 m diameter each for aerodynamic starting were mounted on the 3 blade version of the Darrieus rotor tested among others in the wind tunnel. Adjustable Savonius blades (3 blade-version) enabled to find their most efficient angular position experimentally. By means of a detailed measuring system for the aerodynamic components, for power conditioning and consumption it was possible to assess modifications and optimization steps. Part of this program was the adjustment of the blades of the Savonius-rotor, the lubrication of the gear, the variation of rotor-speed for cut-in of the pre-excitation of the generator and of the switch-points for the different ohmic load resistances thus in connection with a small storage battery simulated operation of a small grid with a large storage battery. The fundamentals have been prepared for the layout of low-cost Darrieus wind turbines in series production including the control and electric energy conversion system.

7229 (BMFT-FB-T—82-109) Measurement studies of a 15 kW-wind power plant. Machens, U. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1982. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750965.

The process in which the wind situation and the corresponding power data of the plant are recorded from instantaneous measurements is a suitable process for comparing different wind power plants in different locations. This process was applied to studies on a small wind power plant having a propeller diameter of 15 m and a power output of 15 kW at a wind speed of 9 m/sec. The simple plant assembled of standard parts is feeding the power to the electricity network. The plant, the synchronizing and switching of the network, the measuring procedure and the measuring equipment are described. The results of the measurements are elaborately stated and discussed. It is shown that the plant is capable to produce the expected power output. The possibilities of increasing the power output and simplifying the synchronizing and switching of the network are also indicated.

7230 (NP—2906254) Wind direction and wind strength, water temperature, oxygen content, salt content and pH in the outer Flensburg Bay near Langballigau during 1973-1979. Neudecker, T. (Bundesforschungsanstalt fuer Fischerei, Hamburg (Germany, F.R.). Inst. fuer Kuesten- und Binnenfischerei). Sep 1980. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82906254.

Since 1973, the Institut fuer Kuesten- und Binnenfischerei, Hamburg, has been operating a field station for research on aquaculture. Data on wind direction, wind strength, and water temperature have been recorded since 1973. All data refer to the restricted area of the research station north west of the Langballigau port.

7231 (PNL—4210) Wake of the MOD-0A1 wind turbine at two rotor diameters downwind on December 3, 1981. Connell, J.R.; George, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1982. Contract AC06-76RL01830. 61p. NTIS, PC A03/MF A01. Order Number DE83003305.

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The wake of the MOD-0A1 wind turbine at Clayton, New Mexico has been measured using a vertical plane array of anemometers in a crosswind plane at a distance of two rotor diameters directly downwind of the turbine. Rotor blade vortices were well mixed into the wake turbulence and were not separately detectable. Wake swirl about the along-wind axis had a value not greater than 0.025 rad/s. Extra turbulence energy existed in the edge of the wake at a frequency of about n=0.025 Hz. The cross-wake plane analyses of wind speeds revealed a nearly circular inner portion and a strongly elliptical portion. The elliptical portion major axis was horizontal. An estimate of the average rate of reenergizing of the wake, using measurements of mean wind energy flow and turbine power, suggests that entrainment with ambient air may have been rapid. Some wake characteristics were compared with the corresponding ones for several simple wake models based upon concepts of mixing of ambient air into a wake or an equivalent coaxial jet. (LEW)

7232 (RISO-M—2310) Testreport for a 15 kW Gyro-mill from Dansk Vindkraft Industri ApS. Rasmussen, P. (Risoe National Lab., Roskilde (Denmark)). Sep 1981. 43p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750323.

This report contains results from measurement of power output and other technical conditions for a 15 kW Gyro-mill prototype. The measuring of power output has been carried out at different adjustment of blade regulation and has been compared with a computed power curve. The measurements were suspended due to technical problems in the gearbox.

7233 (RISO-M—2323) Test of a controller unit for windmills: FREKE AGC 130. Rasmussen, P. (Risoe National Lab., Roskilde (Denmark)). Dec 1981. 17p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750324.

This report contans measurements and an evaluation of a controller unit for cut in and out of an induction generator to a strong electrical grid.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 6692, 6770, 6771, 6772, 6773, 6774, 6775, 6776, 6777, 6778, 6936, 7085, 7260, 7305, 7333, 7377, 7378, 7380, 7413, 7670, 7671, 7681, 7683, 7693, 7750, 7752, 7849, 7849, 7965, 7966

7234 (BMFT-FB-T—82-075) Water injection into compressors of gas turbines for increasing power and reduction of NOsub(x)-emissions. Weichert, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1982. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750699.

1. Testing a set up for water injection into a gas turbine. 2. Evaluation of a method of water injection into the compressor of gas turbines to increase power and reduce emissions of NOsub(X). 3. Using swirl nozzles, collecting large droplets before entering the compressor. 4. Increase of power, reduction of NOsub(X)-emissions were proved. 5. Applicable to all types of gas turbines for different applications.

7235 (CONF-8105173—, pp 16p, Paper 18) **Technical and economic analysis of power stations with vapour gas plants and intra-cycle fuel gasification.** Khristianovich, S.A.; Maslennikov, V.M.; Vyskubenko, Yu.A.; Shterenberg, V.Ya.; Smithson, G.R.; Robson, F.M.; Lemmon, A.V.; Lohon, V.T. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

With the virtual exhaustion of low-cost petroleum and gas reserves, the role of coal has increased not only as an energy fuel but also as a source of motor fuel and as a feedstock in the chemicals industry. This has aggravated the ecological problems involved in the extraction, treatment and utilization of fuel. Efforts to solve the problem of environmental protection by using traditional methods of fuel treatment and power production involve heavy costs, which society is unable to bear without a substantial reduction of living standards. One of the best ways of solving the problem is to establish power and industrial complexes in which the problem of improving methods of power production and the problem of protecting the environment and producing useful by-products are solved simultaneously. The report presents a comparative technical and economic analysis of the simplest power technology complexes that are ready for commissioning, using vapor gas power plants with intra-cycle fuel gasification, and conventional steam turbine power stations with desulphurization of flue gases. Various vapor gas plant designs are analyzed, techniques for the gasification of coal and petroleum residues are examined and assessments are made of the total discharge of harmful substances into the environment. It is concluded from the technical and economic analysis that the use in power engineering of power stations with vapor gas plants and intra-cycle fuel gasification can lead to a substantial reduction of noxious emissions of SO_x and NO/sub x/, volatile ash and thermal discharges into reservoirs, while at the same time reducing the cost of the power produced.

7236 (CONF-8105173—, pp 12p, Paper 27) **Selection of a gasification system for electricity production from British coals.** Robson, B.; Smith, T.F. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

This paper presents the authors' views following a feasibility study, made jointly by the National Coal Board and the Central Electricity Generating Board of the United Kingdom, on the prospects for low calorific value coal gasification applied to high-efficiency electrical power generation. The design and operating objectives of fossil fuelled plants are first discussed in terms of operational requirements, efficiency and reliability and environmental requirements. After considering coal supplies and quality, the methods of coal gasification are considered. In discussing some of the factors affecting gasifier design, it is concluded that the first preference is for air-blown systems because of the potential restraints on flexibility and the cost associated with the use of tonnage oxygen. It is considered inappropriate at this stage to make a prior commitment to atmospheric or pressurized gasification. This is followed by a detailed discussion of the essential features of the three main types of gasification plant, that is, fixed bed, entrained and fluidized bed. Later the practical problems of putting the theoretical concept of a combined cycle into practice are considered. In selecting gasifier types for further development, it is concluded that no generic type can be singled out as being confidently expected to overcome the operational uncertainties and that any development route is subject to considerable technical and financial risk. The report concludes with a discussion of development needs.

7237 (CONF-8105193—, pp vp) **Operating experience of a salt-water cooled power plant.** Weiler, H. 1981. (In German). NTIS (US Sales Only), PC A07/MF A01.

From 2. meeting on corrosion due to salt water; Wilhelmshaven, F.R. Germany (14 May 1981).

Salt-water cooling of power plants requires careful selection and combination of materials. In particular, water quality and solid particle concentrations in the water must be considered. Disturbances caused by small and microorganisms may be prevented by chlorination and protective coatings. If corrosion protection is carefully planned and carried out, power plant operation will not be disturbed by corrosion.

7238 (CW-WR—76-020.107) **High-temperature-turbine technology program. Phase II. Technology test and support studies. Technical progress report, January 1-March 31, 1982.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Aug 1982. Contract AC01-76ET10348. 75p. (FE—2291-107A). NTIS, PC A04/MF A01. Order Number DE83003086.

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This report presents the status of work performed on the High Temperature Turbine Technology Program, Phase II Technology Test and Support Studies during the first quarter of 1982, January 1 through March 31, 1982. Analysis of data from the 100-h test of the Turbine Spool Technology Rig (TSTR) with hot gas stream particulates was completed, as was post-test examination of hot section components. Although there was some mechanical damage to the turbine rotor from foreign materials, essentially all of the hot section components were found to be in satisfactory condition for further operation, and the effect of particulates in the 2600°F gas stream appears no different from that of the earlier less-severe LP rig engine test. The development testing of both the low Btu gas fuel-cooled combustor and high temperature, low emissions coal-derived liquid-fueled combustor have been completed. The results indicate that the performance goals of the low Btu gas-fuel cooled combustor test were met or exceeded at generally lower than predicted metal temperatures. Testing of the water cooled high temperature low emissions rich-burn/quick-quench staged combustor was also successful, burning both JP-4 and SRC-II middle distillate fuels. Some thermal distress was noted on the mushroom fuel injector skirt at test completion, but this problem appears to be corrected by a design modification. Extended time oxidation testing of Nichrome V-Cb material porous mesh for transpiration air-cooled turbine airfoils is continuing; testing to date has reached over 6500 h exposure time toward a planned 10,000 h total.

7239 (EPRI-AP—2693) **Role of design complexity in forecasting reliability and availability for electric-power-generating units. Final report.** Berkey, D.M.; Balaban, H.S. (Arinc Research Corp., Annapolis, MD (USA)). Oct 1982. 123p. NTIS, PC A06/MF A01. Order Number DE83900746.

Portions of document are illegible.

This report examines the relationship between design complexity and reliability and availability performance for fossil-fueled electric-power-generating units. Multivariate regression analysis was applied to design complexity and reliability and availability performance data gathered from a representative sample of electric-power-generating units. Twelve predictive relationships or equations were developed as a result of employing this statistical procedure. Each equation was verified and assessed. Guidelines for applying the predictive relationships, including confidence limits, were also developed and are presented in this report. A major result of this examination is a quantitative predictive tool that should be useful to the electric-power industry.

7240 (EPRI-CS—2594) **Porous dike intake evaluation. Final report.** Ketschke, B.A.; Toner, R.C. (New England Power Service Co., Westborough, MA (USA); Marine Research, Inc., Falmouth, MA (USA)). Sep 1982. 133p. NTIS, PC A07/MF A01. Order Number DE83900747.

The hydraulic performance and screening potential of a porous-dike intake were evaluated in both a laboratory flume and a small-scale field test facility. Two stone sizes were tested, 7.5 cm and 20 cm. Dikes were of gabion construction. The following parameters were evaluated: hydraulic performance, fouling, siltation, zooplankton-screening effectiveness, ichthyoplankton-screening effectiveness, and finfish-screening effectiveness. Flow volume through the porous dike induced by a relatively fixed hydraulic head was dependent upon cross-sectional area (tidal height). Flow resistance increased with time, causing a reduction in flow volume. Flow resistance could be reduced by back flushing. Zooplankton and ichthyoplankton did not appear to avoid entrainment, although some actively-swimming larval fish may avoid entrainment. A high

percentage of the entrained plankton is filtered out by the stones or fouling material. Juvenile and adult fish were neither entrained nor impinged by the stone dike.

7241 **(EPRI-EL—2674-Vol.1) Fiber composite retaining rings for turbine-driven generators. Volume 1: material development. Final report.** Logsdon, W.A.; Marloff, R.H.; Kim, D.S. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Oct 1982. 192p. NTIS, PC A09/MF A01. Order Number DE83900555.

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The overall objectives of the Fiber Composite Retaining Rings for Turbine Driven Generators Program were to develop composite design data, construction techniques and methods of attachment that would support the application of graphite epoxy composites for electrical generator retaining rings. The contractor's approach to the design of an optimum graphite epoxy composite retaining ring involved a combined finite element analysis and material testing effort. The initial phase of this program (Material Development) dealt exclusively with development of the conventional strength of materials parameters under loading conditions representative of intended service requirements as well as special considerations related to the development of rational strength and fracture criteria for composites. Notched body, cracked body and combined mode loading considerations were addressed. The role of nondestructive testing in the characterizing of composite structure quality and overall structural integrity considerations was also included. Results from the vast number and variety of tests conducted in Phase I of the project combined to support the application of graphite epoxy composites for electrical generator retaining rings.

7242 **(EPRI-EL—2674-Vol.2) Fiber composite retaining rings for turbine-driven generators. Volume 2: composite retaining ring fabrication studies. Final report.** Kolek, R.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Oct 1982. 145p. NTIS, PC A07/MF A01. Order Number DE83900556.

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This report, which is for Volume 2 of a four volume final report, describes the activities leading to the successful fabrication of thick wall graphite fiber reinforced spin test rings. These spin test rings were designed and produced in order to define construction, material and manufacturing concepts necessary for the application of composite retaining rings to future full size generator rotors. Baseline composite material and prototype ring test data were established. This led to the selection of the AS-4/3501-6 (Graphite Fiber/Epoxy) material for spin test ring fabrication. Manufacturing and cost analysis studies identified a new method for fabricating these rings. This method, the Bias Ply Winding Process, resulted in high quality rings meeting all specification and spin test requirements. Physical property and friction coefficient data were collected on the spin test rings. This information was used to clarify the retaining ring attachment concepts defined in this program.

7243 **(EPRI-EL—2674-Vol.3) Fiber composite retaining rings for turbine-driven generators. Volume 3: fiber composite ring design and testing. Final report.** Ross, L.L.; Mott, G.; Visser, C.; Gribic, J.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Oct 1982. 138p. NTIS, PC A07/MF A01. Order Number DE83900557.

This Abstract for Volume 3 of a four volume final report covers Phase III of the composite retaining ring program. In this phase, two 0.65 scale model composite retaining rings were subjected to 3000 speed (stress) cycles at 80°C. This test was meant to simulate the many start/stops that an actual retaining ring would experience in the 30 to 40 year life of a large turbine-generator. Finite element computer analyses were performed to determine the stress distributions in full size steel and composite retaining rings and in the scale model test rings. Results of the analyses were compared with the failure criteria. It was correctly predicted that the model rings would withstand the speed cycles. An overstress test was also performed on one of the model rings, subjecting the ring to 2.8 times the stress that would exist at normal operating conditions. Ultrasonic and fluorescent dye penetrant tests were done several times on each ring to determine their conditions before and after the tests.

7244 **(EPRI-EL—2674-Vol.4) Fiber composite retaining rings for turbine-driven generators. Volume 4: attachment and electrical flow considerations. Final report.** Murphy, R.L.; Aivaliotis, E.; Long, L.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Oct 1982. 222p. NTIS, PC A10/MF A01. Order Number DE83900521.

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There are two material properties of the graphite composite that present the designer with unique challenges. First, the electrical resistance is very high which means an additional shorting ring will be required to provide the end connection for the damper circuit. Second, the coefficient of thermal expansion is near zero which means the usual method of heating the retaining ring to shrink fit it on the rotor will no longer work. This report describes all retaining ring requirements that must be met and analyzes several design concepts. The Design Matrix Tool was used to pick the best of three possible alternatives. The metal shield design was clearly the best alternative; however, considerable analysis, material testing, and prototype testing remain to be done before such a ring could be used on a real machine.

7245 **(IKE—1-11) Tube to tubesheet welding by electron beam for heat exchanger application.** Noller, F.; Mayer, H.G. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Jun 1981. 115p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750339.

The EB-process can successfully be used to weld in tubes into tubesheets and also for those materials which are sensitive to hot cracking. The range of qualified welding parameters has been evaluated based on a lot of metallographic and microanalysis inspections. To obtain reproducible and perfect welds a microcomputer controlled welding cycle is recommended using beam deflection, automatic seam tracking, beam current- and focus control. The results can be adopted to the specific conditions of mobile welding equipment with local vacuum.

7246 **(NP—2750325) Energy storage in connection with a power plant based on renewable energy.** Blegna, S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Jan 1981. 137p. (In Danish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750325.

Possibilities of electric power storage in Denmark have been investigated for future power plants based on use of renewable energy sources. Storage methods can be divided into two main groups. The first group consists of air-storage plants, pump- plants, batteries and flywheels where not more than one third of energy stored is lost, while the second group based on hydrogen production (electrolysis, hydrogen, synthetic hydrogen fuels) has losses about 50%. Both storage types can be combined with or used for conversion of electric power into other more useful energy forms. Economic evaluations are based on two projections: that the contribution of renewable energy sources to the total Danish electricity consumption is 1) 50% 2) 75%. However air-storage plants have to use gas oil as fuel which will make this storage form rather expensive.

7247 **(NP—2750326) Economic evaluation of small coal-fuelled dual purpose power plants and district heating plants based on solicitation bid.** (Soenderjyllands Hoejspaendingsvaerk, Aabenraa (Denmark)). Oct 1981. 16p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750326.

The economic investigation based on solicitation bids for turnkey coal-fuelled combined heating-power plants proves that (1) small coal-fuelled heating-and-power plants with electric effect of about 2.4 MW can pay off economically in towns with yearly needs about 140 TJ supplied by district heating, (2) coal-fuelled central heating plants based on use of the normal power-plant coal are expected to give worse economic results than combined coal-fuelled plants, and (3) the economic results of coal-fuelled plants are very sensitive to changes in investment - and operating costs.

7248 **(ORNL/TM—7725) Economic evaluation of the design parameters in utility atmospheric fluidized bed combustors.** Daw, C.S.; Fox, E.C.; Griffin, F.P.; Kahl, W.K. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 91p. NTIS, PC A05/MF A01. Order Number DE83003351.

Atmospheric Fluidized Bed Combustion (AFBC) for utility applications is evaluated by estimating the effect that various design changes could have on the cost of electricity. Estimates of performance (i.e. combustion efficiency, sulfur capture, heat transfer) are made utilizing recent correlations. The capital and operating costs are estimated from the system performance. The results indicate which parameters are important relative to the overall economics and what areas need to be further investigated. Specific recommendations are made for the TVA pilot plant program.

7249 **(PB—82-207465) Preliminary assessment of modular waste-to-energy technology as an energy source for the W. E. Swoope steam plant, New Smyrna Beach, Florida. Technical assistance program report.** (CSI Resource Systems, Inc., Boston, MA (USA)). Jan 1981. 45p. NTIS, PC A03/MF A01.

This report presents the results of a preliminary assessment of the feasibility of resource recovery, in particular, a low-BTU hot gas system, as a means of displacing natural gas used in the City's electricity generating plant. This work involved assessing the technical feasibility of three waste-to-energy concepts under various assumptions of waste throughput and utility boiler operating levels. In addition, study-level estimates were developed. The final aspect of this study involved identifying the major tasks to be performed by the City and the utilities commission prior to implementing a resource recovery project. These activities reflect the results of three site visits to the City of New Smyrna Beach, Florida, and discussions with City officials and personnel from the utilities commission, City of New Smyrna Beach, Florida.

7250 **(TVA/OP/EDT—83/1) Design features of TVA's 20-MW AFBC pilot plant.** Fourroux, J.D.; Dunn, G.C.; Smith, J.W. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). 1982. 13p. NTIS, PC A02/MF A01. Order Number DE83900463.

The TVA/EPRI cosponsored 20-MW AFBC pilot plant test program objective is to provide design information for the development of AFBC for utility steam generating units. Early planning and implementation of the test program has resulted in a flexible facility and test plan that will merge R & D into the utility environment and assure effective development and transfer of this technology to the utility industry, the boiler maker industry, and the architectural engineering firms. TVA is confident that operation of this pilot plant will permit AFBC technology to proceed to the next logical step, a large demonstration plant, in commercialization of this environmentally attractive technology.

7251 **Primary zone air proportioner.** Cleary, E.N. (to Department Of Energy). US Patent 4,353,205. 12 Oct 1982. Filed date 16 Apr 1980. vp.

PAT-APPL-140947.

An air proportioner is provided for a liquid hydrocarbon fueled gas turbine of the type which is convertible to oil gas fuel and to coal gas fuel. The turbine includes a shell for enclosing the turbine, an air duct for venting air in said shell to a gasifier, and a fuel injector for injecting gasified fuel into the turbine. The air proportioner comprises a second air duct for venting air from the air duct for mixing with fuel from the gasifier. The air can be directly injected into the gas combustion basket along with the fuel from the injector or premixed with fuel from the gasifier prior to injection by the fuel injector.

7252 **Effect of coal quality on maintenance costs at utility plants.** Holt, E.C. Jr. (Hoffman-Holt Inc, Silver Spring, MD, USA). *Mining Congress Journal;* 68: No. 5, 48-54(May 1982).

Ten TVA coal-fired power plants representing a broad spectrum of unit size, type, manufacturer, age and configuration were selected for detailed analyses. All areas in these plants were reviewed to determine those susceptible to variations in coal quality. Historical cost records were compiled. The amounts of ash and sulfur to which the particular coal-fired plants were exposed each year were computed. Analyses were performed to determine relationships between coal variations and maintenance costs.

7253 **Computational model for expansion planning of large local electricity and district heating systems including heat storages.** Kaerkkaeinen, S.; Ranne, A.; Sipilae, K. (Technical Research Centre of Finland, Espoo). pp 90-94 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper describes some large simulation and optimization models developed mainly for studies of the energy generation system in the Helsinki metropolitan area. Some examples of the results obtained in these studies are also presented. The purpose of the basic model is to determine the discounted total cost of the energy system for a given time period and plant combination. The operation of the system, including combined heat and electricity generation and separate heat production in Helsinki and electricity generation in the whole country is simulated. The model also includes other parts; one submodel, for ex., simulates optimal use of large-scale heat storage in connection with combined heat and electricity generation plants.

7254 **Multistate performance model of a power generating unit.** Karlsson, B.; Bubenko, J.A. Sr. (Royal Inst. of Tech., Stockholm, Sweden). pp 241-247 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The objective of the modelling discussed in this paper is to determine the impact of component reliability, maintenance strategies, repair personnel, and spare parts on unit performance. The functional interrelationship among the components is described in a tree, which allows for an easy handling of the dynamical system performance as a function of component capacities, component states, and maintenance operations. A solution based on discrete event simulation is proposed.

7255 **Calculation of the replacement cost of generating plant outages.** Boeije, W.S. pp 361-366 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The cost of alternative generation required to replace capacity deficits due to generating plant outages is an important factor in justifying additional expenditure for maintenance and betterment of plant. This paper describes a suitable technique to determine the total cost of alternative generation in an isolated power system (without tie-lines) and the more difficult problem of sharing this total cost amongst the non-available generation.

7256 **New design technique for automatic generation control.** Cuno, B. (AEG-Telefunken, Frankfurt, Germany). pp 677-681 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The problem of the design of Automatic Generation Control is considered from the point of view of modern control theory is considered. Taking the conventionally used method as a basis, a new approach is investigated. A systematic iterative procedure of control parameter optimization is presented which permits the inclusion of all listed demands to the system behavior. In order to illustrate the design and the properties of the control concept, simulation studies on a three-area interconnected power system including both hydro and thermal units are performed. The results as re-

ported are sufficiently encouraging to warrant a more detailed study which is presently underway.

7257 Seasonal planning of a hydro-thermal system based on the network flow concept. Sjelvgren, D. (Swedish State Power board, Stockholm, Sweden); Dillon, T.S. pp 1191-1199 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The seasonal hydro-thermal problem exhibits certain complex features that prevent the use of existing nonlinear programming theory for its solution. The paper presents the development of a method of solution which recasts the problem into a network flow formulation and employs network flow algorithms. Extensions and modifications to network flow theory are developed to incorporate: (1) additional linear constraints, (2) piecewise linear nature of the cost function, (3) nonlinear constraints of the type existing in the seasonal planning problem, and (4) state dependent constraints. This constitutes not only a powerful methodology for solving the seasonal planning problem but also presents a significant advance for the solution of nonlinear programming problems that exhibit such special structure.

7258 Modelling and organization of production planning system for hydrothermal regulation in the Swedish State Power Board. Sjelvgren, D. (Swedish State Power Board, Stockholm); Anderson, S.; Dillon, T.S.; Martin, R.W. pp 1200-1203 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A realistic model of seasonal production planning in the Swedish State Power Board System is described. For implementation of this scheme, for its use by operational engineers an inforation system is set up which will enable efficient handling of data bases and computational routines.

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REFER ALSO TO CITATION(S) 6695, 6727, 6750, 6751, 6752, 6753, 6755, 6756, 6757, 6758, 6759, 6760, 6761, 6762, 6763, 6764, 6766, 6767, 6768, 6769, 6811, 6815, 6860, 6914, 6915, 6916, 8344

7259 (BMFT-FB-T—81-229) Project study for the desulfurization of flue gas by the Bergbauforschung-Process (BF-Process) in an integrated operation with the chemical industry. Roesner, H.; Oed, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750415.

The sophisticated BF-Process for the desulfurization of flue gas is an advanced technology, as is verified by the operating prototype plant at Luenen and by a demonstration plant erected at the GKM site using modified desorption. Without cooling the flue gas the BF-Process provides an SO_2-rich gas as an intermediate product that is further processed to liquefied SO_2 or to H_2SO_4. The liquefaction in the GKM is not discussed here, since presently no large-scale SO_2-CO_2 separation units exist. Any treatment of the enriched gas requires scrubbing that can be performed by way of the liquid waste treatment method that supplies - in unimportant quantities - a final product with good storage characteristics by adding calcium hydroxide.

7260 (BMFT-FB-T—82-123) Improvement of the performance of electrostatic precipitators through conditioning by flue gas. Jury, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750995.

1. Present state of research: The influence of conditioning of flue gas by water on the performance of electrostatic precipitators was unknown. 2. Objective and justification: The positive effect known from other applications was to be investigated in connection with power station precipitators since the increasing use of coals of varying characteristics may considerably aggravate operating conditions. 3. Method: After the air preheater, water is injected through spraying nozzles into an evaporation vessel to cool down the flue gas. 4. Result: The precipitator efficiency rose, e.g. with flue gas that had been cooled down from 154 to 90°C, from 89 to 97,6%. The plant has been working troublefree for approx. 22 months. 5. Conclusion: Conditioning by means of water can be applied in the case of cyclone boilers. The precipitator size can be reduced. The reduction of the temperature permits an adaptation to the coal characteristics.

7261 (CONF-8105173—, pp 18p, Paper 3) Introductory report. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The total energy consumption of the ECE region between 1973 and 1978 was characterized by an average yearly increase of 2.3 percent, in sharp contrast to the more than 4 percent yearly increase which prevailed during the 1960s and early 1970s. The energy supply structure, which in 1978 consumed 73 percent of the world's commercial energy, will evolve rather slowly under the influence of substitution policies. By 1990, total energy demand in the ECE region is expected to increase by 40 percent in comparison with 1978. No dramatic change in the supply pattern is foreseen except for an almost five-fold increase in nuclear electricity production. Fossil fuels would still cover 85 percent of the energy needs of the region. Longer term estimates indicate that the energy consumption is likely to double by the year 2000 and triple by the year 2020. Projected supply patterns for 2020 are different from those which prevailed in 1978: a 4.4-fold increase would characterize coal utilization, as a result of technologies such as coal gasification and liquefaction whereby coal would provide one third of the ECE energy supply; absolute amounts of oil and natural gas consumption are expected to be approximately the same as in 1975; an estimated 40-fold increase in nuclear electricity would provide one third of the ECE energy supply; and a 4.5-fold increase in the use of renewable sources of energy to about 10 percent. Such trends, if unchecked, could lead to large increases in transboundary air pollution derived mainly from the combustion of sulfur-containing coal and fuel oil.

7262 (CONF-8105173—, pp 6p, Paper 15) State of the art in and application of methods for desulphurizing combustion products. Shcherbakova, A.G. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In the USSR, environmental protection is one of the most important economic and social tasks of the State. The Air Protection Act, which provides for a sharp reduction in discharges of pollutants into the environment, was adopted in 1980. The paper reviews the methods for reducing the total discharge of sulfur dioxide into the atmosphere that have been developed and used in metallurgical enterprises and thermal power stations in the Soviet Union. It shows that the most promising method for the non-ferrous metals industry is a technique that has been developed and perfected for cleaning gases by reducing sulfur dioxide with natural gas and coal dust to produce elemental sulfur (the Norilsky Ore-dressing Combine). Methods for cleaning gases with low and variable sulfur dioxide content are described. Gases from enterprises in the iron and steel industry are desulphurized by the limestone method. A plant with a capacity of 3 million m^3 of gas per hour has been constructed at the Magnitorgorsk Iron and Steel Combine and has been in operation for 15 years; cleaning takes place in high-speed scrubbers with a cleaning efficiency of 85 to 90 percent. Methods for using desulphurization residues are suggested and the major factors determining the efficiency of the process are described. A technical and economic analysis is made of the application to thermal power stations in the USSR of methods (developed or perfected in other branches of industry) for reducing sulfur oxide emissions by means of: flue gas desulphurization by various methods (ammonia cycle, magnesite, limestone, etc.); the destructive processes for treatment of solid and liquid fuel before combustion (pyrolysis and gasification) so as to remove sulfur compounds from the products.

7263 (CONF-8105173—, pp 4p, Paper 17) **Desulphurization of flue gases by regeneration methods (magnesite, ammonia cycles).** Brodsky, Yu.N.; Glakdy, A.V.; Lazarev, V.I. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Further improvements are being made in the USSR in the magnesite and ammonia-cycle methods for removing sulfur dioxide from flue gas. Tests carried out on the magnesite method show that it is possible to obtain sulfur as a by-product of purification by reduction roasting of magnesium sulphite crystals. This broadens the scope of application of the magnesite method in which, with the existing system for roasting magnesium sulphite crystals, the end product of purification is sulphuric acid. The State Scientific Research Institute for Gas Purification has developed a process for the desulphurization of flue gases using the magnesite method to obtain elemental sulfur. For the ammonia-cycle method, a pilot plant for the desulphurization of flue gases has been designed. It will desulphurize 500,000 m^3 per hour of gas obtained from the combustion of sulphurous coal from the Moscow area, using a technique that requires no previous cooling and is carried out at an absorption temperature of 60°; this precludes the formation of waste water requiring neutralization. The technical and economic calculations for the desulphurization of gas in the report are given, based on the above methods for a 500 MW coal-burning thermal power plant, in accordance with the procedure recommended by ECE.

7264 (CONF-8105173—, pp 18p, Paper 34) **Dry flue gas desulphurization technology.** Ahman, S.; Lillestolen, T.; Farrington, J. Jr. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Dry flue gas desulphurization (FGD) has rapidly expanded in the past three years as an economical means of SO_2 abatement for low-sulfur coal applications. Its rapid development from a few small-scale pilot plants to full-scale contracts for a total of 3500 MW without a single prototype demonstration plant is remarkable. Unlike the first commercial application of wet lime/limestone technology in the early 1970s, dry FGD is often said to be merely a new combination of several proven technologies. Although the current process concept was suggested as early as 25 years ago in a Czechoslovakian patent, the recent impetus to exploit western low-sulfur coal reserves has stimulated the current explosion of dry FGD technology. Dry FGD is traditionally considered as two separate technologies: spray drying and dust collection. An alkali absorbent reacts with SO_2 in a dryer spray where a dry reaction product is formed. This reaction product together with flyash is then collected in a conventional dust collector which is usually a fabric filter. The first installation in Europe has recently been sold in Sweden with start-up in October 1982. The technology as such is expected to gain an extended use in the United States as well as in Europe not least due to its simplicity and low cost in comparison with traditional all-wet scrubbing technology.

7265 (CONF-8105173—, pp 17p, Paper 41) **Results on reduction of SO_2 emission from brown coal fired boilers.** Hein, K.; Glaser, W.; Schiffers, A. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Based on research results from combustion trials for Rheinish brown coals, a flue gas desulphurization process using dry basic oxides as additives with the fuel has been proposed. The applicability of this process was tested in a programme over several years at a brown coal-fired utility boiler (175 tons/h steam production). Following a description of the specific fuel properties, the main test results are presented in the paper. It is shown that the so called natural retention ability of brown coal can be improved by blending calcium based additives with the fuel prior to the grinding system. Different reactivities and, hence, variable SO_2 removal efficiencies are determined for the additives investigated: $CaCO_3$, $Ca(OH)_2$, CaO and dolomite.

7266 (CONF-8105173—, pp 2p, Paper 42) **Recycling of desulfogypsum.** Wirsching, F.; Hamm, H.; Hueller, R. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In the desulphurization of combustion gases of power stations by means of lime and limestone scrubbing processes, desulfogypsum occurs in the form of a moist, fine-particled powder which can be utilized as a raw material in place of natural gypsum. Since desulfogypsum comes from different lime and limestone scrubbing processes, the physical and chemical characteristics differ. Differences are mainly encountered in the crystal habitus, the particle size distribution and the bulk density. Homogenizing is obtained through compacting according to the KNAUF process. Handling of the desulfogypsum and anticyclic output and consumption requires, compared to natural gypsum, different supplementary facilities. Drying and compacting make handling less complicated and make ordinary intermediate storage and simple mixing and blending of different qualities possible. The value of desulfogypsum as a raw material is derived by comparing costs with those of natural gypsum at the place of utilization. In addition, expenditures for transportation, intermediate storage, drying and compacting become necessary for desulfogypsum. These expenditures can be ascertained objectively. By means of specific measures, these expenditures, which in most cases are higher compared to natural gypsum, can be reduced. The most significant measures to be taken are: drying with waste heat in the power station or the gypsum plant; and selecting a desulphurization process which compares favorably as regards costs and which above all operates on limestone instead of quick lime or hydrated lime. In this respect the KNAUF-Research-Cottrell process offers special advantages, because it operates with limestone and without special additives or chemicals.

7267 (CONF-8105173—, pp 11p, Paper 44) **Limestone additive procedure for flue gas desulphurization in the case of burning raw brown coal of the German Democratic Republic.** Kluge, W. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Under the conditions prevailing in the German Democratic Republic since 1970 numerous industrial tests have been carried out concerning the dry limestone additive procedure. The level of its development is characterized by the fact that the procedure is suited for an indigenous fuel - raw brown coal - without affecting the capacity of steam generators, and will bind the toxic flue-gas components with a readily available material of a sufficiently high efficiency and without causing an additional environmental load. The total internal energy consumption additionally necessary amounts to 1 percent and will be compensated by a possible use of extraneous heat so that an energy gain of 5 to 6 percent arises. The social expenditure is low and is covered by the proceeds from supplementary heat in the case of most variants of application. The investments to be expended in the national economy for this purpose are extremely low in comparison with other procedures for flue-gas desulphurization and lower than those for a central heating plant, as they are equivalent to additional heat. Additional or supplementary heat means such heat that is gained from waste heat and which is utilized.

7268 (CONF-8105173—, pp 1p, Paper 48) **Desulphurization of industrial gases Societe francaise Hoechst process.** Marcopoulos, M. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The Societe francaise Hoechst is developing a desulphurization process for industrial gases which makes use of the especially attractive properties of glyoxylic acid for SO_2 absorption. Glyoxylic acid absorbs SO_2 very readily but the SO_2 can be recovered from it equally readily in gaseous form. The SFH process is thus a reversible process which does not yield a by-product but which can be used to remove SO_2 from industrial gases by concentrating the SO_2 in a gas stream which can then be either recycled or given special treatment. The process has not yet been refined to the point where the various costs of its application (investment, running costs, etc.) can be exactly calculated, but the results obtained with it are well worthwhile and include: very good purification of gases; very good process reversibility; a highly concentrated stream of SO_2; and very low consumption of material and energy. It should

be added that the SFH process calls for no chemical engineering operations other than simple traditional ones, and that a variant of the process can be applied to gases containing SO_2.

7269 (CONF-8105173—, pp 10p, Paper 50) **Alternatives and supplements to technological methods: progress report on the experience in Italy.** Gasparini, R.; Landini, P.; Merluzzi, D. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The protection of air quality is based on Law No. 615 of July 1966 and on the related regulations for enforcement. The regulation pertaining to industries, enacted in 1971, is based mainly on ground level emission control rather than on emission control; in fact, it sets upper limits for ground concentration of pollutants discharged by industrial processes. However, the legislation refers only to special areas where pollution is expected to be high and where adequate safeguards are deemed necessary. As a first step, these areas were identified as the major metropolitan areas. For large stationary sources equipped with high stacks, such as thermal power stations, limitations concern mainly ground level emissions. According to the aforesaid regulations, the SO_2 ground level concentrations due to industrial emissions are not to exceed 0.15 p.p.m. over 24 hours and 0.30 p.p.m. over half an hour. For thermal power stations these two limits are further lowered respectively to 0.10 and 0.25 p.p.m. The technique adopted for ground level pollution control is based on the combined use of high stacks, sophisticated monitoring networks and appropriate stocks of low-sulfur fuel oil. The monitoring equipment consists of five to eight stations for continuously recording SO_2 (and dust, in the case of coal-fired plants) concentrations at ground level and readings from meteorological instruments. Computers are designed and equipped to: characterize the air quality at ground level in the areas around the station in different situations; determine and record the impact of the station on ground level concentrations; distinguish between the situations in which the station contributes appreciably and those where it does not contribute at all; and provide the basic data for development of a behavioral model of the area.

7270 (CONF-8105173—, pp 16p, Paper 51) **By-products of the desulphurization of fuels and flue gases: amounts, quality and utilization.** Haug, N.; Lange, M. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

With the combustion and conversion of fuels and the use of emission reducing measures, especially for the separation of sulfur dioxide and dust from flue gases, residues accumulate which should be supplied to the market to a maximum extent for further profitable use as commercial products. If a profitable further use of residues is not possible for ecological, technological or economic reasons, they must be dumped in an ecologically sound way, observing sewage and waste disposal regulations. Special consideration is to be given to the expected increased use of domestic and imported hard coal for electric power generation. Here and also in the case of imported crude oil, declining fuel quality is to be expected so that the corresponding residue quantities from combustion and from the use of improved separation facilities for SO_2 and dust will continue to increase in the future. Combustion residues (bottom and fly ash) from hard coal power plants are utilized by up to more than 50 percent in the Federal Republic of Germany - most versatilely in the construction industry. Sulfur, which accumulates as a by-product from gas and oil desulphurization as well as from some flue gas desulphurization processes, can be sold profitably. There are also adequate markets for other products of flue-gas desulphurization, such as sulphuric acid, ammonium sulphate and gypsum. The lime processes for flue-gas desulphurization with gypsum as an end product currently have the largest share of the market in the Federal Republic of Germany. After treatment, this gypsum is of high quality. The emphasis of future utilization will be in the construction sector. Moreover, its utilization will not only extend to substituting it for natural gypsum but to other uses, as gypsum from flue-gas desulphurization can be employed in new fields of application.

7271 (CONF-8105173—, pp 8p, Paper 59) **Flue-gas desulphurization for brown coal fired boilers.** Hackl, A.E. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

The various sorts of brown coal differ in some respects from hard coals. Nevertheless, there are no real difficulties in desulphurizing flue-gas from brown coal fired power plants. This is proved by some big power plants equipped with different desulphurization processes using wet scrubbing procedures or dry additive procedures. Based on these positive results and good experience observed during a long period of operation, new brown coal fired power plants, which are planned or in construction both in Europe and the United States, will be equipped with flue-gas desulphurization processes.

7272 (CONF-8105173—, pp 27p, Paper 60) **Regenerable flue gas desulphurization systems in the United States.** Kaplan, N.; Maxwell, M.A. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Eight regenerable flue-gas desulphurization (FGD) systems are currently in operation in the United States, representing 1600 MW or about 6 percent of the total FGD controlled capacity. An additional six regenerable systems under construction or planned will increase the controlled capacity to 3588 MW, an increase of approximately 120 percent over current levels. There are three primary regenerable FGD systems currently available for commercial applications: Mag-Ox (magnesium oxide), Wellman-Lord and citrate. A fourth process, aqueous carbonate, is under development for testing on a 100 MW utility boiler. Of the 1600 MW of capacity controlled by regenerable FGD systems, 96.3 percent employ the Wellman-Lord process. These systems are capable of removing 90 to 95 percent of the sulfur dioxide from flue gas. The principal advantages of regenerable FGD systems over nonregenerable systems are the economic advantages gained from the elimination of waste disposal problems and the sale of recovered by-products. Waste water streams are collected and can be neutralized by standard treatment systems, and most of the spent solution can be recirculated to the process. Solid waste loads are also considerably reduced. However, regenerable systems are more complex than current nonregenerable systems and involve higher capital investment and higher operating costs. Markets for by-products have not been fully developed, and utilities are reluctant to depend on fluctuating by-product markets. It is anticipated that regenerable systems will become more attractive as credit for by-products increase; land costs (for disposal) increase; and regulations for disposal become more stringent, especially in urban areas where sludge disposal is not permitted.

7273 (CONF-8105173—, pp 30p, Paper 61) **Nonregenerable flue gas desulfurization systems in the United States.** Kaplan, N.; Maxwell, M.A. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

In June 1980, 65 of the 73 flue gas desulphurization (FGD) systems operational at utility plants in the United States were nonregenerable systems, representing 23,000 MW or 93.5 percent of all FGD-controlled generating capacity. An additional 89 nonregenerable units were under construction or planned, representing about 45,000 MW, an increase of about 200 percent of controlled capacity. It is projected that by 1990, the contribution of nonregenerable systems to total controlled capacity will drop slightly from 93.5 percent to 92.1 percent, based on known commitments. The four processes discussed in the paper - wet lime, limestone, sodium alkali and dual alkali - are all in commercial use at one or more full-scale utility plants. The wastes from three of these processes - lime, limestone and dual alkali - are principally mixtures of calcium sulphite, calcium sulphate and varying amounts of fly ash. At a few plants, the calcium sulphite is converted to calcium sulphate by means of forced oxidation. The thickened, filtered and treated wastes from these three processes are generally placed in ponds or landfill sites. Currently, the FGD systems installed at utilities are primarily lime and limestone scrubbing processes. These account for more than 80

percent of the FGD-controlled capacity. The lower initial cost and the lower sensitivity to boiler load changes has made the sodium alkali process attractive for use with industrial boilers, although its operating cost is higher than some of the other systems. The capital costs for the type of FGD systems considered in the paper range from $88.81 per installed kW for the sodium alkali process to $106.50 for the dual-alkali process (1979 dollars). The range for total annual operating costs is 4.88 mills/kWh for the limestone process to 6.79 mills/kWh for the sodium alkali system.

7274 (CONF-8105173—, pp 36p, Paper 62) **New developments: dry processes and combined SO/sub x/ and NO/sub x/ removal.** Brna, T.G.; Martin, G.B. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Coal-fired industrial and utility steam generators are a dominant source of SO/sub x/ emissions and a major source of NO/sub x/ emissions in the United States today. Control of sulfur oxides emissions from coal-fired boilers in the United States has thus far been achieved principally by means of wet scrubber systems. Two leading alternative technologies for SO/sub x/ control are (a) dry scrubbing and (b) limestone injection with modified burner (LIMB). The latter controls emissions of nitrogen oxides as well as sulfur oxides. Dry scrubbing has been specified for about 3600 MW of new power plant capacity in the United States over the past few years, and its selection for new western coal fired plants is expected to be extensive. These systems are mainly lime-based spray dryer and baghouse combinations and promise economic advantages over wet limestone scrubbing under the present New Source Performance Standards for utility boilers. An approach to the simultaneous control of SO/sub x/ and NO/sub x/ employs two techniques - limestone injection for SO_2 removal and burner modification for NO/sub x/ reduction - combined in a LIMB configuration that offers significantly improved SO_2 removal performance. The combustion conditions created by the modified burner also reduce NO/sub x/ formation significantly. This combined technology is the subject of an active research and development programme leading to complete field evaluation in 1985. The technology is applicable to both new and retrofit applications. The goal of the programme is to achieve at least 50 to 70 percent reduction of SO_2 emissions and 50 to 60 percent reduction of NO/sub x/ emissions at a capital cost below $40/KW and annual revenue requirements in the order of 4 mills/kWh.

7275 (PB—82-208158) **Assessment of advanced coal-based technologies for use in California. Final report.** (Radian Corp., Austin, TX (USA)). Nov 1980. 303p. NTIS, PC A14/MF A01.

This report assesses the potential for the use of 24 advanced coal-to-electricity technology combinations in California. For each technology combination, the SO_2, NOx, and particulate emissions were estimated for both the fuel production and fuel-to-electricity conversion technologies. The capital and operating costs were estimated and levelized for a 35-year plant life. The uncertainties associated with these estimates were addressed, and both the cost and emissions estimates were normalized with respect to an advanced coal-fired power plant.

7276 (PB—82-221763) **Effect of emission control requirements on fluidized-bed boilers for industrial applications: preliminary technical/economic assessment. Final report Jan-Sep 79.** Ahmed, M.M.; Keairns, D.L.; Newby, R.A. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Sep 1981. 191p. NTIS, PC A09/MF A01.

The report gives results of an assessment of coal-fired industrial fluidized-bed boilers (FBBs) to estimate the impact, on boiler cost and performance, of alternative control levels for SOx, NOx, and particulate emissions. Base industrial FBB conceptual designs are presented, and the cost, boiler plant energy efficiency, and environmental performance are estimated as a function of boiler size, coal characteristics, sorbent properties, and boiler design and operating conditions.

7277 (PB—82-224940) **Evaluation of PCB destruction efficiency in an industrial boiler. Final report.** Hall, J.; Record, F.; Wolf, P.; Hunt, G.; Zelenski, S. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Apr 1981. 172p. NTIS, PC A08/MF A01.

The report describes the evaluation program undertaken to determine the polychlorinated biphenyl (PCB) destruction efficiency during a May 1980 verification co-firing of waste oil containing approximately 500 ppm of PCBs, in accordance with applicable state and federal regulations, in a high-efficiency industrial boiler owned and operated by General Motors Corporation at Bay City, MI. Also investigated was the environmental and workplace impact which occurs during the handling and combustion of PCB-contaminated waste oils.

7278 **Biological colonization of an industrial pond: status after two decades.** Rickard, W.H.; Fitzner, R.E.; Cushing, C.E. (Battelle Pacific Northwest Lab., Richland, WA). *Environmental Conservation;* 8: No. 3, 241-248(Aug 1981).

The biological status of an isolated, man-made pond established in 1957 is described principally after its first 20 years of existence. The pond is located in the dry sagebrush region of south-central Washington (USA), and is colonized by bulrushes, cattails, and numerous algae. Migratory waterfowl were the first vertebrate users of the pond; and with the establishment of shoreline plant communities and submerged macrophytes, the pond now provides nesting habitat for several duck species, American coots, and pied-billed grebes. Use of the pond by large mammals is limited to visits by mule deer, coyotes, and raccoons.

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REFER ALSO TO CITATION(S) 7101, 7102, 7253, 7254, 7257, 7258

7279 (BMFT-FB-T—82-082) **Telecommunication in power systems using optical fibre cables.** Brueggendieck, S.; Gladenbeck, J.; Herff, R.; Krahn, F.; Nolting, K.H.; Olejak, G.; Meininghaus, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 22p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750727.

Due to their good transmission characteristics optical fibres have already found practical application in diverse buried cable systems. Their insensitiveness to electromagnetic interferences makes them particularly well suited for the use in power systems, if the mechanical problems can be solved. Using metallic and non-metallic supporting elements two cable types have been developed: The first type is free of any conductive material. It is reinforced by glass and Aramid fibres. The second type can be used simultaneously as high voltage conductor. An armouring of Aldrey wires provides for conductivity and tensile strength. Furthermore an optical control system for monitoring the position of switches in switching stations has been developed.

7280 (BMFT-FB-T—82-132) **High power cable with internal water cooling 400 kV.** Rasquin, W.; Harjes, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1982. 15p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751002.

The project was planned for a duration of 4 years. Afterwards it has been extended over 6 years and finally stopped after 3 1/2 years. Therefore, of course results of field tests with an internally cooled 400 kV cable are not available. Nevertheless, this conductor cooled high power cable has been developed to such an extend, that this manufactured cable could withstand type tests according to IEC/VDE recommendations. Even by missing field tests it is obvious that a high power cable for 400 kV is available.

7281 (EPRI-EL—2699-Vol.1) **Transmission-line grounding. Volume 1. Final report.** Dawalibi, F. (Safe Engineering Services Ltd., Montreal, Quebec (Canada)). Oct 1982. 434p. NTIS, PC A19/MF A01. Order Number DE83900569.

A generalized approach to transmission line grounding has been developed and is presented in this report. Dedicated interactive computer programs based on advanced analytical models presented in the report have been developed and verified. Theoretical predictions from the computer programs are in good agreement with several measurements including data from transmission line staged fault tests conducted within the scope of this project. Typical problems are used to describe in detail the steps required to design transmission line grounds using the computer programs and design charts developed for this project. Measurement equipment and techniques are described in depth. Recommendations are provided to enhance the practicality, accuracy and usefulness of the transmission line grounding measurements.

7282 **Transmission line including support means with barriers.** Cookson, A.H. (to Department Of Energy). US Patent 4,352,949. 5 Oct 1982. Filed date 29 Aug 1979. vp. PAT-APPL-070582.

A gas-insulated transmission line includes an elongated outer sheath, a plurality of inner conductors disposed within and extending along the outer sheath, and an insulating gas which electrically insulates the inner conductors from the outer sheath. A support insulator insulatably supports the inner conductors within the outer sheath, with the support insulator comprising a main body portion including a plurality of legs extending to the outer sheath, and barrier portions which extend between the legs. The barrier portions have openings therein adjacent the main body portion through which the inner conductors extend.

7283 **Superconducting VAR control.** Boenig, H.J.; Hassenzahl, W.V. (to Department Of Energy). US Patent 4,348,630. 7 Sep 1982. Filed date 5 Dec 1980. vp. PAT-APPL-213275.

Static VAR control means employing an asymmetrically controlled Graetz bridge and a superconducting direct current coil having low losses and low cost characteristics.

7284 **Mathematical dynamic optimization model for electrical distribution system planning.** Goenen, T.; Foote, B.L. (Univ of Mo, Rolla, USA). *International Journal of Electrical Power amp Energy Systems;* 4: No. 2, 129-136(Apr 1982).

A dynamic mixed-integer programming model is presented that has been developed to solve a distribution system expansion problem. The results of the study indicate that the computerized modelling approach is a promising tool that can provide considerable savings to the electrical utility industry in reducing not only planning man-hours but also the fixed and variable costs of distribution system operation and the final cost to the consumer. 8 refs.

7285 **Analysis of power-flow equation.** Araposthatis, A.; Sastry, S.; Varaiya, P. (Univ of California, Berkeley, USA). *International Journal of Electrical Power amp Energy Systems;* 3: No. 3, 115-126(Jul 1981).

The qualitative properties of the power-flow equation for a transmission network are studied in terms of global and local aspects, as well as stability. Global aspects include estimates of the number of solutions and topological properties of the stable region. Local aspects are examined through bifurcations of the flow equation. 15 refs.

7286 **Proceedings of the seventh power-systems computation conference.** Laughton, M.A. (ed.). Guildford, England; Westbury House (1981). 1221p. (CONF-810797—).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

One-hundred-eighty-one papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

7287 **Data bases for power system calculation.** Baumann, R.; Bayer, R. (Technical Univ., Munich, Germany). pp 3-8 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Large Data Base (DB) management systems have been developed for commercial applications. Since the volume of data to be processed in technical power system calculations also increases continuously there is rising interest in using DB systems for power systems calculations also. A detailed requirement analysis based on a proposed classification of DB approaches is combined with a survey of the state of the art and indications of further development needs.

7288 **Parallel processing in power systems.** Happ, H.H. (General Electric Co., Schenectady, NY). pp 9-16 of Proceedings of the seventh power-systems computations conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper presents a brief status report of the emerging computer architectures and their probable influence on power system computing. Experiences with three groups of computers will be reviewed, namely, the supercomputers, array processors, and multi-processor networks. The computer hardware available directly determines the practicality and optimality of computational techniques or procedures. They are also largely a limiting factor in computations.

7289 **Optimization methods in planning and operation of power systems.** Carpentier, J.; Merlin, A. pp 17-29 of Proceedings of the seventh power-systems computations conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Research in optimization initially began in the 18th century. But it is only after World War II that, with the development of more and more powerful computing tools, this branch of applied mathematics advanced very rapidly. The planning and operation of power systems constitute an exceptional application field for optimization methods, especially because of the high financial costs that the construction and operation of these systems entail. In this paper, we shall give only some examples illustrating the way these methods are used in the field of power systems.

7290 **Microprocessors in electric power systems.** Sekine, Y. (Univ. of Tokyo, Japan); Tamura, Y.; Yamaguchi, H.; Yamakoshi, Y. pp 30-37 of Proceedings of the seventh power-systems computations conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A summary is made of the present status of microprocessor applications in various fields of electric power systems. Special attention is directed towards development trends in the protection field where microprocessor applications are expected to cope with the increasingly stringent requirements for electric power supply reliability. Also discussed are history, roles, design philosophy and basic schemes of microprocessor-based protective relaying systems. Only recently, has their application reached a practical stage after long term study and repeated field tests.

7291 **Emergency control.** Di Caprio, U. (Centro Ricerca di Automatica, Milan, Italy). pp 38-52 of Proceedings of the seventh power-systems computations conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The main trends in the development of the techniques presently used for the emergency control of electric power systems are illustrated, from load-shedding to islanding, generator control, automatic reclosure of circuits, reactive power control and auxiliary aids in the control centers. The methods under study for improving the design criteria are reviewed.

7292 General LP model for transmission planning. Adams, R.N.; Deif, M.K. (Queen Mary College, London, England). pp 55-60 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A general LP model is described which can be used for long term network reinforcement or contingency studies. Additions or deletions of branches and busbars are simulated by a current injection vector thereby minimizing the problem that B-matrix modifications present in LP procedures. Structural aspects of the LP formulation are discussed, and the model is then further refined using mixed integer LP.

7293 Load management and its impacts on electric generation planning. Sekine, Y. (Univ. of Tokyo, Japan); Kato, M.; Nagao, T.; Arakawa, F. pp 61-65 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The effect of load management (load shift due to the introduction of time-of-day rates and peak-load-cut) on the optional generating plant composition is discussed. The program developed for this study consists of two models: consumption model and generation planning model. The main conclusions obtained are as follows: peak-load-cut gives little economical advantage though it plays a very important role in securing the power system reliability; and load reduction by means of higher rates at peak period has less effect on the total revenue and expenditure than the new creation of load by lowering the offpeak rates.

7294 Algorithm to determine the most economical cable profiles for l-v branched distribution system. Allam, M.F. (Univ. of Riyad, Saudi Arabia); Megahed, I.Y.; Ali, M.M. pp 66-71 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An algorithm for calculating the most economical design of a continuously tapered branched radial lv distribution system is presented. It is based on two assumptions, the voltage drop is a limiting factor for the system layout network topology conceived by the planning engineer and the rate of change of system branch coat (including cost of losses) with respect to its voltage drop is constant. These result in two sets of equations: one is linear and the other is non-linear. Their solution satisfies the system main criterion, namely, most economical cost, voltage drop and thermal rating limits, from selected standard cable size.

7295 Long range planning of optimal extensions in high voltage transmission network. Laiho, Y. (Helsinki Univ. of Tech., Otaniemi, Finland); Maekelae, L. pp 77-79 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The planning program that can be used to compare alternative network extension strategies is described. Reinforcement alternatives are generated by the planner interactively. Full ac load flow and loss minimization computations are performed to get realistic voltage profile and loss estimation. After a number of alternatives is available optimum reinforcement sequence can be sought. Cumulative information of earlier studies is utilized. The example shows the application of the program in the long range extension planning of 400 kV network.

7296 Power generation expansion planning using a multiple criteria decision method. Climaco, J.C.N.; Traca-Almeida, A. (Univ. of Coimbra, Portugal). pp 80-84 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Traditionally, linear programming models judge the generation expansion planning problems by the single objective approach of total system cost. Nowadays, several social measures and foreign dependency have also become essential to evaluate the relative merits of the alternative schemes. The main purpose of this paper is to discuss the application of a multiobjective linear programming algorithm to an outline study of the expansion policy for a power generation system suggested by the Portuguese one. Emphasis is placed on the post-optimal analysis. A sensitivity analysis method afforded by duality concepts for multiobjective linear programming is discussed. A multiobjective planning model with interval criterion coefficients is also proposed.

7297 Modelling utility financial performance for alternative generation expansion plans against an uncertain future. Rattray, W.G. (South of Scotland Electricity Board, Glasgow, Scotland); Pope, I.T. pp 85-89 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Under conditions of uncertainty the return on the capital assets of a utility can be reduced below satisfactory levels by the introduction of a project to the overall financial performance of the utility by a probabilistic risk assessment technique. A range of scenarios can be considered including movements in fuel prices, load forecasts and existing plant performance as well as parameters of the various alternative projects such as performance and capital cost. Results are expressed as the probability density function of overall rate of return of the utility with each of the competing projects.

7298 Long term model of electric energy systems and evaluation of macro effects against energy impacts. Toyoda, J. (Seikei Univ., Tokyo, Japan); Takahashi, K.; Sekine, Y. pp 95-96 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In problems surrounding power systems, it is fundamental but unsolved problems to evaluate the flexibility and rsponsibility of power system for maintaining normal ability to supply sound electric energy in meeting the external impacts, such as fuel crisis scarcity of generating site and so on. The object of this paper is to develop the method for evaluating the intrinsic strength of power system quantitatively against various external shocks. The toughness of power system is proposed as a new index which is expressed in term of the interrelation between impact to the power system and effect incurred within the power system itself. This paper is an interim report describing fundamental considerations on the concept of toughness and some simulation results.

7299 Network reliability evaluation: peculiar problems to be faced when planning bulk meshed transmission systems. Facchinei, I.; Salvaderi, L.; Giampieri, E.; Scalcino, S. pp 97-103 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

For a long time, ENEL has been using a program based on the Monte Carlo Method for quantitative evaluation of transmission and interconnection system reliability. Nowadays, the increasing application of that program in real complex network planning has set out new problems and the need of further enhancements that need to be carried out. Such implementations are described with examples of quantitative applications.

7300 Moving window approach to generation expansion optimization. Day, J.T.; Le, K.D. (Westinghouse Electric Corp, Pittsburgh, PA). pp 106-107 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In the development of generation expansion plans, a question arises as to what time period should be analyzed. Usually a fixed planning period is studied, say 20 years, to capture the long range impact of near term installation decisions. An approach has been developed which uses a moving time period or window for expansion plan optimization. This allows control of the impact of future events on near term decisions and a reduction in computer time required to develop a plan.

7301 **Integrated hardware/software package for power system planning.** Dechamps, C.; Fuchsova, J.; Jamoulle, E. (Systems-Europe S.A., Brussels, Belgium). pp 108-109 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper is an introduction to SEPLAN: an integrated and interactive hardware/software package for supporting the basic technical analysis needs of planning and operation departments in electric power systems. Implemented on a low-cost computer, SEPLAN can be used without excessive room-conditioning requirements in regional control centers of a large power system or in the main control center of a smaller power system, e.g. in developing countries. The computer hardware is a PDP 11/34 processor, supporting several work-stations. The software consists of a basic set of compatible network analysis programs: optimum power flow, short-circuit and stability programs for power systems of up to 100 buses and 40 generators, and complemented by an integrated data base management system.

7302 **Fast algorithms for solving long term power plant mix problems.** Hamam, Y. (Ecole Superieure d'Ingenieurs en Electrotechnique et Electronique, Paris, France); Renders, M.; Trecat, J. pp 110-117 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The main problem faced during the modelling of long term power plant-mix problems is the number of variables associated with the representation of generation plant operation conditions. In this paper the special characteristics of the problem are exploited to obtain a partitioning which separates the problem into a large linear programming problem solved very efficiently by an adapted algorithm and a small problem of the general linear programming type. Benders algorithm is used to derive the iterative procedure. In the case of pumped storage units a procedure, derived from the generalized capacitated transshipment problem and a special algorithm is developed which minimizes the computational requirements. The methods developed have been implemented and the computational experience since early 1979 is presented.

7303 **Use of heuristic graph-search algorithms in power and energy planning.** Gonzaga, C.C.; Persiano, R.C. (Federal Univ. of Rio de Janeiro, Brazil). pp 118-119 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

When facing a sequential decision problem, as planning problems use to be modelled, a planner usually chooses between two alternatives: he either adopts Dynamic Programming or Depth First Branch and bound as solution method. This choice is made because these are the most widespread methods, and not because they are the best. This paper is a reminder that for deterministic discrete sequential decision problems, graph search techniques (which include B & B) provide excellent tools which are usually better than either DP or Depth First B & B. The best results are obtained by the A algorithm, which is described in the paper. Its application to Power and Energy planning is then exemplified by some real-life projects carried on by Brazilian planning organizations.

7304 **Long-term expansion of power transmission systems.** Persiano, R.C.; Gonzaga, C.C. (Federal Univ. of Rio de Janeiro, Brazil). pp 120-124 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A method or planning the expansion of a power transmission system over a period of several years is described. Using short-term expansion procedures as a successor operator, a graph is constructed of possible expanded configurations whose optimal paths are associated to optimal planning policies. The resulting graph-search problem was solved by a heuristic programming method using adaptive estimates. The example presented in the paper was provided by Eletrobras, the Brazilian holding company for power planning, where the method has been implemented and is presented being used.

7305 **New probabilistic model for long-term planning studies of ehV power transmission systems using a stochastic subgradient method.** Dodu, J.C. (Electricite de France, Clamart); Hertz, A.; Quadrat, J.P. pp 125-133 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Seeking the optimum localization of generation facilities is one of the fundamental problems which occur in long-term planning studies of a power transmission system. This article describes a new calculation tool, recently worked out at Electricite de France and which allows to determine this localization making a cetain number of simplifying assumptions: the EHV network is represented by a graph comprising about 50 nodes and 100 arcs; Kirchoff's first law is the only one retained; the variables representing the investments are continuous variables. As opposed to this, the model takes into account the unavailabilities of generation and transmission equipment and the consumption uncertainties. The method used is based on an algorithm of stochastic subgradient, which results in much shorter computer times, as compared with a linear programming method.

7306 **Electrical networks technical-economical analysis on the basis of criterions parameters.** Pospelova, T.G.; Pospelov, G.E.; Sich, N.M.; Zapatrin, R.I. (Byelorussian Polytechnical Inst., Minsk, USSR). pp 134-146 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A mathematical model for determining the energy losses, efficiency, load flow, stability, and economics of power transmission systems is presented. (LCL)

7307 **Direct method for bulk power system reliability evaluation.** Moslehi, K.; Wu, F.F. (Univ. of California, Berkeley). pp 149-153 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981). Contract AS01-77ET29136.

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The reliability of a bulk power system is defined as the probability of the set of states for which the dc load flow is satisfied with a particular demand and there are no line overloads. A direct method to find such a set of working states which does not require the solution of a load flow is proposed. The method involves (1) replacing two sets, one defined by the constraints on line flows and the other by the constraints on phase angles, by two families of hyperboxes, and (2) identifying the states for which there exist points in a pair of hyperboxes, one from each family, that satisfy the flow-angle relations. The theoretical foundation of the method is presented in this paper.

7308 **Bounded set theoretical approach to reliability calculations.** Cheong, H.K.; Dillon, T.S. (Monash Univ., Clayton, Australia). pp 154-161 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A bounded-set theoretical approach is given for evaluating the loss of load probability and frequency of failure of a composite generation-transmission power systems. The method is essentially based on the concept of a cumulative frequency and duration approach. The use of sets of system states in considering transition between system states has a remarkable effect on the computation effort required for solution and produces a mathematically and computationally tractable method. Exact and approximate methods for computing bounds for the chosen reliability indices are also given. Effects of unconventional energy sources and dispersed character of the load are included in the modelling. Applications of the solution method to power systems represented by a linear network flow and dc load flow model are given.

7309 **Evaluating the contribution of system control to the reliability of the power system: Part I.** Kaiser, W.; Glavitsch, H. (Swiss Federal Inst. of Tech., Zurich). pp 162-169 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper presents a method for the effectiveness evaluation of system control in electric power systems. Contrary to the conventional methods of reliability analysis this approach requires a new abstract model of operation because system control cannot be modeled the same way as the behaviour of a component, e.g., possible changes in the system by reserves and control actions have to be included. This fact is shown by means of a small system. Furthermore the new approach is described and its applicability is demonstrated with the IEEE reliability test system.

7310 **Evaluating the contribution of system control to the reliability of the power system: Part II.** Rossier, C.; Germond, A. (Swiss Federal Inst. of Tech., Lausanne). pp 170-175 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A hierarchical simulation model for the analysis of long-term power system's behavior is described. The effects of centralized (functions of the control center) and decentralized (protection apparatus, generator speed governor, ...) control devices are considered. The modular structure of the model allows the inclusion of new control functions or more complex system's representation.

7311 **Algorithms for reliability studies of complex electric power systems by the analytical method.** Kovalev, G.F.; Rudenko, Yu.N. pp 176-185 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An engineering statement of the problem for determining the reliability indices of complex (multi-machine) electric power systems, imposed assumptions and design conditions is presented. The mathematical formulation and algorithms for evaluation of the required reliability indices are given as well.

7312 **Simultaneous outages of components in power system networks.** Bitzer, B.E.; Gebler, H.R.; Koglin, H.J. (Technical Univ. Darmstadt, Germany). pp 186-192 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In this project, more than 1000 disturbances with outages in the German 110 kV networks were analyzed, in order to gain an accurate insight into the essentials of disturbances. From this, new types of models have resulted for the dependent outage of several components. At the same time a new computer program was developed, which can calculate whole networks in a short period of time. With the aid of the models and the program the reliability of an actual 110 kV network was quantified. For the first time the results could be verified in comparison with reality.

7313 **Forecasting the permissible level of risk in assessing short term system operation reliability for the power system.** Nitu, V.I.; Petrescu, A.M. (Inst. for Power Studies and Designs, Bucharest, Romania). pp 193-200 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The short-term system operation reliability forecast for the optimum planning of units and transmission system for the next day as well as for the safe on-line control calls for a perfect knowledge of the maximum permissible level of risk of unreliable operation. This paper means to present a method for the forecasting of the permissible level of risk in the course of time from the power system reliability on, as quantified by the reliability function. At the same time the paper proposes a heuristic model for the self correction of the permissible level of risk (NAR) on the basis of which system operation decisions have to be substantiated as well as the day by day planning activity of the power system.

7314 **Mathematical models for determining the maximal reserve of loads in electric power systems.** Hausdorf, D.; Rausendorf, S.; Hirsch, P.; Schaller, D. (Technical Coll. Zittau, Germany). pp 201-202 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Mathematical models for determining the maximal reserve of electric loads in electric power systems are presented, which permit the optimization of this reserve by observing of constraints, for instance of voltages at nodal points and conductor currents. Their results give importnat information for management and planning. Moreover this reserve may provide a means for estimating the sensitivity of the network in view of the uncertainty of system demand.

7315 **Power systems reliability estimation with the help of digital computers.** Fokin, A. (Moscow Power Engineering Inst., USSR). pp 203-209 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Modern power supply systems of industrial enterprises and towns are characterized by a large number of design elements, consumers and load centers even in comparatively small electric systems; by the influence of many accidental factors on power demand, by automatic and manual commutation apparatus in schemes. All this makes it difficult to describe formally system operating conditions in reliability calculations. Reliability calculations are of great importance at present in the designing and reconstructing of power supply systems. The main problems in estimating reliability of power supply systems are discussed and include: working out and realization of reliability indices calculation methods which take into account the logic of power supply system operation and envisage formalization of one of the most labor-consuming reliability design schemes on the basis of electric schemes; estimation of power deficiency due to local faults and limitation of the capacity of elements; and substantiation and application of fast approximate methods of load centers reliability estimation as a basis of the synthesis of schemes with a specified reliability level.

7316 **Network reliability evaluation: reduction in computer time.** Bertoldi, O. (ENEL, Milan, Italy). pp 210-215 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

One of the major obstacles encountered in the reliability study of a bulk meshed electric system, is the computing time required to obtain reliable results. An algorithm has been set up for the fast calculation of postfault load-flows, which also makes it possible to exploit to the maximum the advantages provided by the ordered triangular factorization method for the solution of sparse coefficient matrix systems. By implementing the algorithm and inserting it in an existing computational code, a considerable reduction in the computing time required was, given the same result confidence limit, achieved.

7317 **Concepts and techniques for generation reliability modeling including operating considerations.** Patton, A.D. (Associated Power Analysts, Inc., Bryan, TX); Singh, C.; Ayoub, A.K. pp 216-224 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Newly developed analytical methods of computing generating system reliability indices are presented, whereby operating considerations are taken into account. The idealizing assumptions commonly made are relaxed, and the computed indices are rendered more realistic.

7318 **Computational aspects in the reliability evaluation of composite systems.** Allan, R.N. (UMIST, Manchester, England); Arruda, C.; Barbosa, F.M. pp 225-229 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper discusses the concepts associated with the reliability evaluation of composite generation/transmission systems and describes evaluation techniques that have been developed at UMIST. These techniques enable both system and busbar indices to be evaluated and allow the various contributions, insufficient generation, uneconomic despatch, line overloading and load point isolation to be identified separately. The techniques are applied to the IEEE Reliability Test System (RTS) and the results discussed.

7319 **Development of an electrical equipment reliability information system in Canada.** McGillis, D. (Hydro-Quebec, Montreal); Baribeau, M. pp 230-235 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In 1975, the Canadian electrical Association adopted a proposal to create a facility for the centralized collection, processing and reporting of reliability data on generation, transmission and distribution equipment. This paper describes the Equipment Reliability Information System in terms of scope, basic definitions and results. The paper is divided into two parts. Part I describes the portion of the information system which deals with generation equipment and presents an analysis of three years of operating experience of $\sim$ 600 generating units. Part II is a description of the data processing system proposed for the implementing of this information systems.

7320 **Exact and approximate techniques for including parameter uncertainty in generating capacity reliability evaluation.** Billinton, R.; Hamoud, G. (Univ. of Saskatchewan, Saskatoon). pp 236-240 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The most popular technique used in generating capacity adequacy evaluation is the Loss of Load Expectation (LOLE) method. The LOLE index when treated as a random variable is affected by uncertainties in the generating unit forced outage rates and the forecast peak loads. Probabilistic methods for evaluating the effects of these uncertainties on the LOLE index have been developed and applied to hypothetical systems. These methods can be time consuming when applied to large power systems. This paper presents an approximate technique which overcomes the bulk of these difficulties and by which any correlation between system parameters can be easily considered. The described method applied to both single and two interconnected systems.

7321 **Transmission system reliability evaluation considering protection system malfunction.** Nordin, A.; Bubenko, J.A. Sr. (Royal Inst. of Tech., Stockholm, Sweden). pp 248-255 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A model of transmission system reliability performance is developed to handle protection system malfunction and its impact on system reliability. Failures of breakers and relays to operate and isolate a fault as well as false operation, when no action is required, are modeled. The system states encountered due to a fault are identified and reliability parameters for the states are accumulated from all fault cycles. Finally, an economic appraisal of the systems reliability is made in form of calculating the costs of interruptions.

7322 **Topological aspects of distribution system reliability.** Adams, R.N.; Jasmon, G.B. (Queen Mary Coll., London, England). pp 256-260 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The structural features that influence the reliability of distribution networks are discussed. It is shown that additional interconnections can reduce reliability by increasing the risk of active failure due to protection or circuit breaker failure. The effect of alternative substation configurations is assessed and finally the rather different topological requirements of security against line overload are identified.

7323 **Decomposition-Monte Carlo approach for multi-area reliability calculations.** Clancy, D.P. (Pacific Gas and Electric Co., San Francisco, CA); Gross, G.; Wu, F.F. pp 261-269 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A computationally efficiency scheme for evaluating the reliability of large interconnected power systems such as power pools and reliability councils is presented. The systems are modeled as networks with probabilistic arc capacities. A combined state decomposition and Monte Carlo method is developed for evaluating reliability. A new reliability index, the inadequate transfer capability, is introduced. The method has been implemented into a production-grade program. The application of the program to a seven area example for planning system enhancement is given. Data on computational times are also presented.

7324 **Improved allocation of generation through dynamic economic dispatch.** Raithel, R.; Virmani, S.; Kim, S.; Ross, D. (Systems Control, Inc., Palo Alto, CA). pp 273-280 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper describes the theory, test results and implementation considerations for the dynamic dispatch of generating units. Successive approximation dynamic programming is used to obtain the optimal unit generation trajectories that meet the predicted area load. Rate of change and operating limits are taken into account as are manually specified unit output trajectories. The dynamic dis-

patch algorithm is part of a broader effort directed towards the development and field testing of an integrated set of algorithms for Automatic Generation Control (AGC).

7325 **Search of optimal switching configurations in power transmission system studies.** Dodu, J.C.; Merlin, A.; David, J.M. (Electricite de France, Clamart). pp 281-292 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An approach to find the optimal switching for an electrical network, in the dc approximation is discussed. The proposed method consists in determining an upper bound and lower bound of the optimal operation cost, this knowing a list of lines liable to be disconnected. These two bounds are computed by means of a linear programming algorithm, based on a relaxation method. It results in very short computation times, for up to 220 nodes and 600 lines networks. If the margin between upper and lower bounds is not excessive one can estimate the efficiency of the disconnections intended by the network manager in order to minimize the load-shedding risk.

7326 **Use of quadratic forms in power system analysis.** Glavitsch, H.; Spoerry, M. (Swiss Federal Inst. of Tech., Zurich). pp 293-300 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The quadratic relationship of nodal quantities to state variables requires a more detailed consideration when a general model for the power flow is needed. This becomes obvious for the optimal power flow to be used for minimization of losses, active-reactive dispatch, etc. Based on the basic quadratic forms a compact relation the socalled extended incremental load flow is derived which serves as an equality constraint for the optimization problem. Inequality constraints are treated by Kuhn-Tucker variables. The performance is illustrated by the treatment of a 80 node sample network.

7327 **Optimal constrained power flow applied to the Swiss power system.** Asal, H.P. (Elektrizitaetsgesellschaft Laufenburg, Switzerland); Glavitsch, H.; Kronig, H. pp 301-305 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The need of a versatile optimal power flow program comprising economic dispatch, security enhancement, voltage profile etc. is emphasized. Before a particular problem for the Swiss power system is treated a valid model reproducing realistic voltage-reactive power relations is established. This is done by inserting PV-nodes in generator locations and at the border to neighboring networks which are represented by equivalents. As a case for the optimal power flow the adjustment of the voltage profile is treated. Of the four groups of generators the closest to the buses of interest is the most effective one. General conclusions for the voltage control are derived.

7328 **Linear programming applied to reactive power flow optimization in high voltage power systems.** Chamorel, P.A. (Federal Inst. of Tech., Lausanne, Switzerland); Germond, A.J.; Rudaz, M. pp 306-310 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Linear programming application for optimal active power flow under constraints shows very good results, without causing particular problems. However, the same technique is more difficult to apply to reactive power optimization, due to the non-linearity of relations between the reactive power injections and the voltages. An iterative and decoupled method, based on optimization of injected reactive currents, for minimizing the production cost and active losses under bus voltage and branch flow constraints, is proposed. An illustrative example applied to an actual 220/125 kV network shows the possibilities, the efficiency and the limits of this method.

7329 **Optimal power flow for hvdc networks embedded in ac systems.** Prada, R.B. (PUC, London, England); Cory, B.J. pp 311-318 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An optimal power flow algorithm capable of handling combined hvdc and ac networks with constraints is described. Operating strategies are calculated, secure against single outages in either the ac or dc portions of the system. Security enhancement through the algorithm enables comparisons of operational flexibility to be made between pure ac systems with embedded dc networks. Examples are given of the optimal operation of ac and dc systems and the advantages apparent in embedding multi-terminal dc systems within a large ac system are discussed.

7330 **Optimal short-term reactive scheduling for a large power system.** Franchi, L. (ENEL, Milan, Italy); Innorta, M.; Marannino, P.; Mariani, E.; Sabelli, C.; Sapora, D. pp 319-326 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The problem of the optmization of the operating conditions of a large power system, by utilizing the reactive control variables is discussed. Particular attention has been devoted to the definition of an object function for the security. The possible implementation of the short-term scheduling in a control center is described. An algorithm, based on the iterative solution of quadratic programming problems for the automatic reactive scheduling is presented together with a heuristic procedure which approximate the same objectives. Some results of the simulation performed with the heuristic procedure on the ENL network are presented.

7331 **Reactive aspects of security in optimal power flows.** Carpentier, J.L. (Electricite de France, Paris). pp 327-334 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Two important points are presented about reactive aspects of security in optimal power flows: first, for line current constraints, a linear development of the current versus the voltage magnitudes is not always satisfactory and may even give a dangerous instability of the algorithms; a second order development solves this problem. Second, a new algorithm is presented for voltage level security, which consists of defining the voltage level in the intact system in such a way that after any single trip, voltage at every reactive generation bus remain feasible. This algorithm is extended to the case when a secondary voltage control exists.

7332 **Estimation of outage envelope shape in power systems.** Kozik, Z.; Malko, J.; Mromlinski, L.R. (Technical Univ. of Wroclaw, Poland). pp 355-360 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The outages area is designated by the process of a maintenance power variation in time. This might be defined with the arbitrary assumption of a power system operation reliability and the installed capacity to be calculated or with the determined course of installed capacity and the reliability coefficient to be found. Both methods are described. Estimation of outage envelope shape allows the generating units scheduling to be executed.

7333 **On-line economic control of the Iberduero hydro thermal systems.** Garrido, J.A. (Iberduero, S.A., Bilbao, Spain); San Pedro, J.L.; Zabalza, R.L.; Kilmer, R.E.; Lessans, E.J.; Lawrence, D.J.; Mikolinnas, T.A.; Ringlee, R.J. pp 367-374 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The features and performance test results of the on-line economic control systems for Iberduero are described. Economic scheduling and control is performed for the system for up to 15 fossil fueled and nuclear generating units and thirty five hydro projects. The hydro projects are located on four major watersheds and are used to carry the majority of the regulating requirements of Iberduero. Iberduero has major connections at 400 kV with France, Portugal, and the balance of Spain. A detailed system simulator was developed to model the watersheds, hydro and thermal projects, and electrical system loads and interchanges to both test the on-line economic control principles and to tune the control parameters prior to installation and actual on-line control.

7334 **Execution times of MIP models for the economic operation of electric power systems.** Harhammer, P.G.; Pranger, S. (IBM Oesterreich, Vienna). pp 383-386 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Estimations of computer execution times of planning models optimizing the operation of electric energy systems are a relevant factor in evaluating their practical applicability in advance. Therefore, systematic investigations were done to achieve comparable practice-oriented results.

7335 **Economic operation of energy systems.** Harhammer, P.G. (IBM Oesterreich, Vienna). pp 387-392 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper presents a contribution to the economic planning of the operation of public and industrial energy systems. The theory of MIP (Mixed Integer Programming) modelling of electric power systems is generalized and extended in order to be applicable to all line-based single and multiple coupled energy systems (e.g., district-heating, gas, steam, water) with different energy carriers.

7336 **Chance constrained approach to the problem of long term regulation of hydro-thermal systems.** Dillon, T.S. (Monash Univ., Clayton, Australia); Martin, R.; Sjelvgren, D. pp 393-401 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Long term regulation of hydro-thermal systems is complicated by stochastic factors such as inflow, load variations and unit availability. An approach to the solution of this stochastic hydro-thermal problem using chance constrained programming is presented. An equivalent that is linear in structure is derived by recasting the hydro-thermal problem into a more appropriate formulation. As the solution obtained makes the control dependent on past realizations of the random variables, the solution possesses a feedback character. The computational feasibility of the method is illustrated by application to an example problem.

7337 **Application of pseudo-inverse matrix technique to stabilization of power swing.** Toyoda, J.; Uriu, Y. (Seikei Univ., Tokyo, Japan). pp 417-424 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Totalized control policy of multiple stabilizer is discussed by using the simplified model of power system. A pseudo-inverse matrix technique is applied for realization of the state-feedback-type control policy. Stabilizing action is determined by the frequency deviation at the generator bus. A simulation model of five generators was prepared for evaluating the damping ability of totalized stabilization proposed. Typical stabilizers are simulated. They are power system stabilizer as a typical measure to stabilize power swing by voltage change, dynamic braking resistor as typical measure for stabilizing power swing by energy consumption and switching series capacitor as typical a measure for which damping action is done by the change of network parameter. Simulations of the totalized stabilization show satisfactory results.

7338 **Homeostatic control: a summary.** Schweppe, F.C. (Massachusetts Inst. of Tech., Cambridge). pp 425-432 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Homeostatic control is an approach to electric power system control and operation based on the principals of customer utility cooperation while maintaining customer independence in decision making. It is achieved by exploiting the microelectronic revolution. Spot pricing and microshedding establish an open energy marketplace for electric power. Buy and buy back spot prices vary every 5 minutes depending on supply demand conditions. Different qualities of power (e.g., reliability) are sold. Marketplace operation usually involves computers negotiating with computers. Decentralized dynamic control uses sophisticated electronics to move certain control actions from the large generation plants to the customer loads while still fulfilling the customer's desires.

7339 **Experiences with on-line evaluation of short-circuit levels in a part of the Swiss grid-system.** Nordanlycke, I. (INTERCOMPRO, Zurich, Switzerland); Asal, H.P.; Oesch, F.; Fischer, H. pp 433-438 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Due to the continuous growth of both generation and transmission networks, the level of the fault currents increases. Short-circuit (SC) currents of such high magnitudes have already been experienced in the West-European network that an operation with separated busbars is necessary. To ensure regularity of supply of energy, it must be secured on-line that the fault currents do not exceed the capacity of the breakers. At EGL this security function is designed as an interactive SC-program using true on-line data and implemented on a PDP 11/70 process computer.

7340 **Experiences with an extended on-line-security based power control system.** Asal, H.P. (Elektrizitats-Gesellschaft Laufenburg AG, Switzerland). pp 439-448 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In order to provide power of high availability and quality to the customers in West-Europe the interconnected power grid is operated commonly by the related utilities of the UCPTE organization. For a part of this power system a new extended on-line-security oriented control system has been implemented. Based on the main functions of the utility, this power control system includes not only new data control functions and an on-line technique for network topology determination but also an effective State Estimator with bad data supression and overload control. A special data base for security assessment is used for on-line-short-circuit calculations and for the on-line-evaluation of the optimal constraint power flow.

7341 Computer aided development of power system restoration plan. Adibi, M.M. (IRD Corp., Bethesda, MD); Kafka, R.J. pp 449-453 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An approach to development of system restoration plans is described. The plan covers restoration of power following a complete system collapse for a metropolitan electric system under both light- and peak-load conditions. The approach is based on: the combined effort of operating personnel and system analysts, the concurrent use of control computer and interactive computer systems, and applicatoin of available analytical tools. The paper concludes that system restoration plans can significantly be improved when both groups and both systems are located at the operating center of the power system. The results presented should be of interest to other organizations engaged in power system operation.

7342 On-line microcomputer control of converter systems. Sucena Paiva, J.P. (Inst. Superior Tecnico, Lisbon, Portugal); Amaral Alegria, C.M.; Freris, L.L. pp 454-461 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A new generation of microprocessor-based controllers for power converters is described. Since the individual phase control (IPC) system has long been abandoned, only the digital equivalents of the voltage controlled oscillator based control systems are dealt with. A clear distinction is made between Pulse Frequency Control (PFC) and Pulse Phase Control (PPC), which in a μP-based system differ only in the software. The control algorithms for the PFC and for the three versions of the PPC developed so far are presented, together with small-signal discrete models. Finally, the performance of the four variants is compared.

7343 Hvdc multiterminal transmission network planning using mixed-integer linear programming. Gilles, M.L.; Meisel, J. (Wayne State Univ., Detroit, MI). pp 462-468 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Continuing development on hvdc-converters and on high capacity dc-circuit breakers will make multiterminal dc-networks feasible as an alternative in transmission expansion plans for ac-power systems. The methodology presented gives a basic simplified view of this problem. Given an existing ac-power system, which may be disjoint, explicit specifications can be made for desired changes in generation and load levels, limitations on ac-branch angle differences, and dc-converter and line power levels. Feasible solutions consist of both a dc-multiterminal structure and an operating state for this structure. The optimal solution is that particular feasible solution having a minimum cost for the dc-converters and lines required. The formulation produces a mixed integer linear-programming problem solved through specialized branch-and-bound techniques.

7344 First experiences with computer-aided corrective switching. Koglin, H.J.; Mueller, H. (Technical Univ. of Darmstadt, Germany). pp 474-481 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The application of corrective switching actions with the aim of improving the state of the network has enlarged the scope of optimal loadflow by a further dimension. In the following contribution, a method will be described for finding a solution, despite the huge number of switching variants in real networks, within a short time. This enables the utilization in on-line operation. On the one hand the procedure is based on a specific reduction of the variants and on the other hand based on the speedy analysis of variants. For the first assessment a dc-load flow in an extremely reduced network is used. The following lists the first experiences in correcting the state of overloaded networks.

7345 Optimization in electric heating load management. Tamminen, E.; Aho-Mantila, J. (Technical Research Centre of Finland, Otakaari). pp 482-486 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Electric heating load may be switched off during peaks of the total electricity demand. After switch-on the heating load shoots over to recover the undelivered energy. A deterministic problem is formulated which gives the optimal load control strategy if we have perfect information of the load, i.e., the control which reduces the peak with a maximal amount. The control strategies consist of the switching time points for different heating loads in the system. The influence of control on the load is described by technology dependent effect functions. The admissible control set is determined by technical and capacity factors. This model is used as a module in a stochastic simulation study for the real problem.

7346 Special kinds of fault control in power systems. Cheban, V.M.; Dolgov, A.P.; Fishov, A.G. (Electrical Engineering Inst., Novosibirsk, USSR). pp 487-491 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Power systems enlargement and further complication of their structures results in the necessity of improving conditions control algorithms, developing new methods of fault control. Further development of fault control systems is based on using the control computers enabling to implement universal optimization methods in control algorithms. However, it should be noted that the opportunities of the overall optimization of transients in modern complicated power systems by the engineering means and methods available at present are rather limited. Therefore, the problem is decomposed into a number of more particular ones within which the optimization is accomplished and automatic fault control structure is constructed allowing for the above decomposition and subproblem peculiarities. With the disturbances in the system, the automatic control should ensure the steady state stability of post-fault conditions and the dynamic stability of the associated transient. This type of fault control and methods for fault control optimization, using mathematical models, are discussed. It is concluded that: the calculation of steady-state (aperiodic) stability limitation in operation conditions and optimization of the load-restricting automatic controls operation is feasible when employing the interconnection between the convergence of the SCE (steady-state condition equations) solution by the parametric method (based on Newton's law) and aperiodic stability; the phase control to be accomplished both in stator and in rotor circuits of synchronous machines is one of fresh methods of fault control in power systems and the selection of optimal control actions is feasible on the basis of the equivalent circuit overall parameters; and the phase control laws derivation involves predicting fault development. Several methods of prediction and the ways of their accomplishment are considered.

7347 Very short term load forecasting: description of an efficient method. Mueller, H. (Technical Univ. of Vienna, Austria); Layr, P. pp 495-499 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In Austria the power supply accounting interval between the national electricity board and the regional boards is half an hour. The load dispatchers are interested in getting information about the mean half hour load demand to be expected at any time in the course of such an interval. A forecast model suited for this purpose is described. It calculates at every minute a prediction of the mean half hour load demand for the current accounting interval. First an extrapolation is calculated according to Holt's 3-parameter-model with an error difference term. This initial forecast is then adjusted

twice - in both cases by means of information derived from one or several previous days used for comparison.

7348 **Application of the innovation method of random series in power system short-test load forecasting.** Xu, L.Z. (Electric Power Research Inst., Beijing, China); Du, J.G. pp 500-507 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The random-time series method is used in establishing the load model of a power system, and the self-adaptive system of innovation method of random series is used for predicting its load. This latter method has proved to be time-saving, simple, convenient and free from serious error, and it does not require much memory space. The results obtained are satisfactory. It is an effective tool for security analysis and economical operation of power system. Innovation variance is also used as reliability criterion for load forecasting and as quality index, which is used to identify the irrational data.

7349 **How to deal with errors in network data.** Borkowska, B. (Computer Centre of Power System, Warsaw, Poland). pp 513-519 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The results of work on large errors in data teletransmitted to load dispatching centers are presented. Classification of errors in topological signals and measurements is proposed. The method has been described, which eliminates large errors in data, using logical function. This function, which is filtering and modifying the coming data is formulated based on the knowledge of power system and telecommunication equipment. Examples of this function are shown.

7350 **Short term load forecasting of the Hungarian load dispatching.** Nemeth, A. (Power Station and Network Engineering Co., Budapest, Hungary); Nagy, I. pp 520-525 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The Daily Load Forecast (DLF) program package of the Hungarian National Control Center's (NCC) process control computer system is discussed. The calculation itself is a so-called learning machine self-organizing approach. Input data are such factors as temperatures, weather, day type, etc., output data are the hourly demands, daily total consumption, etc. The use of the DLF system is typically useful for the NCC personnel's on-line daily operation. The accuracy of the calculation is very favorable as can be seen from the results.

7351 **Data uncertainties in power system reliability evaluations.** Edwin, K.W.; Siemes, B. (Technical Univ. of Aachen, Germany). pp 526-534 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In recent years much work has been done for the development of suitable methods for power system reliability evaluations, partly taking into account the uncertainties of the necessary input data, given on principle. However, there is supposed that these uncertainties themselves are already quantified. This paper presents suitable methods which characterize these data uncertainties, founding on Bayesian statistics. The problem of quantifying them by appropriate probability distributions is emphasized. Results of applying these methods to the determination of the necessary power reserve are shown. Particularly, relations between the uncertainties of power reserve determination and the size of the statistical data available and limits of the accuracy of reliability evaluations, given on principle, are shown.

7352 **Influences of input data inaccuracies on the accuracy of short-term load-forecasts.** Edwin, K.W.; Roellinger, H. (Technical Univ. of Aachen, Germany). pp 535-539 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper presents an investigation of the influences of input data inaccuracies of short-term load-forecasting. Therefore four typical load-forecasting models have been developed, which are described in this paper. The possible inaccuracies of each input data are determined. The detailed effect of these inaccuracies and of each considered influence factor on the results of short-term load-forecastings are described. Finally a comparative evaluation of the developed models for five large data sets is carried out and the possible decrease of operation cost of power station systems by the application of computer load-forecasts is determined.

7353 **Effect of unit commitment in stochastic and probabilistic load flow.** Edwin, K.W.; Loenig, D. (Technical Univ. of Aachen, Germany). pp 540-544 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The paper presents a realistic model of unit commitment for stochastic analysis of load flows in electrical networks. the proposed model allows the consideration of non-linear dependences of random variables in Stochastic- and Probabilistic-Load-Flow, which are caused by unit commitment. Fast Monte Carlo simulation techniques, which simulate indices of the dependences, are combined with analytical solution methods. An example illustrates the effect of the consideration of unit commitment. The accuracy of the presented methods and the applicability is shown.

7354 **Computerized small area load forecasting.** Willis, H.L.; Northcote-Green, J.E.D.; Powell, R.W. (Westinghouse Electric Corp., Pittsburgh, PA). pp 545-552 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Methods for computerized small area load forecasting fall into three categories: trending, multivariate, and simulation. A survey is made of the resources needed to effectively apply each of these methods in general. Specific examples of each type are quantitatively examined and compared. Specific examples of each type are quantitatively examined and compared. Trending methods require a minimum of data, computer time and manpower. Multivariate methods involve sophisticated, high precision calculations on substantially more data than trending. Simulation forecasting requires extensive data but rather simple mathematics. The complexity of the multivariate and simulation methods is justified by their greater forecast accuracy.

7355 **Interactive short-term load forecasting program.** Lajda, P. (Brown Boveri & Co. Ltd., Baden, Switzerland); Reichert, K. pp 553-558 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Besides the accuracy of the prediction, the simplicity of the prediction calculation is also of essential importance. Only a program which is comfortable to use can be a useful tool for the dispatcher. A prediction model and an interactive short-term load forecasting program will be discussed here. The load prediction is based on a four load components model: weather-dependent, deterministic, time-dependent and small unpredictable fluctuation. The program structure and man-machine dialogue will be described and an application presented.

7356 Estimation of the sensitivity of the electrical energy demand to variations in meteorological conditions: history of methods and development of new approaches at Electricite de France. Meslier, F.; Ernoult, M.; Mattatia, R.; Rabut, P. pp 559-572 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The development of electrical heating makes French consumption of electrical energy more and more sensitive to climatic random variations and this considerably complicates the a posteriori analysis of realizations, not only for itself, but also as a help in forecasting. The necessity of having homogeneous realizations as far as meteorological conditions are concerned, has led, for many years now, to diverse research and development projects at EDF; here, we propose a comprehensive survey of our activities in this area until the end of 1980, by presenting the results which we have obtained by various techniques (linear or non-linear regression methods, ARIMA models with transfer function and adaptive filtering techniques).

7357 On-line procedure for active load forecasting. Anelli, R.; Maini, M.; Marchese, V.; Pozzi, S. (ENEL, Milan, Italy). pp 573-580 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper describes an on-line load forecasting procedure that has been implemented on a Varian 73 computer and tested in a 4000 MW area of the Italian network. The main object of the experiment was to validate the procedure in view of an implementation of the forecasting function in the new ENEL Power Generation and Transmission Control. The main features of the on-line forecasting algorithm are outlined as well as a clarification of the requirements for the design of the data acquisition system and for the criteria of the data validation. Finally, some results showing the main performances of these procedures are presented and the suggestions drawn for the above mentioned application.

7358 Pragmatic approach for short-term load forecasting using learning-regression method. Fu, S.T. (Electric Power Research Inst., Beijing, China). pp 581-587 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A pragmatic approach for short-term load forecasting is proposed. This method uses regression method to predict the nominal load, and learning method to predict the residue load. A modified Learning Machine based on well-known probability theory is developed, which can consider the influence of meteorological factors with improved prediction accuracy and reduced memory requirement. This method has been tested on a sample power system using recorded load data and weather data. It is shown by test results that the prediction error is acceptable for practical operation.

7359 Development and implementation of an interactive demand validation and prediction facility. Farmer, E.D. (Central Electricity Research Labs., Leatherhead, England); Laing, W.D.; Adatia, A.M.; Baker, A.B.; Bunn, D.W. pp 588-598 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An interactive on-line demand validation and prediction facility has been developed at the CEGB National Control Centre. This development has been effected in two stages; in the first, an automatic on-line system was implemented, and this facility was, subsequently, enhanced to permit the integration of off-line forecasts of demand extremals, into the predictive calculation. Two procedures for effecting this synthesis were formulated, the first being an optimum statistical method, the second being a deterministic procedure. Results obtained from an on-line implementation of the latter method are presented; these demonstrate the utility of the interactive facility, in combining the dynamical response of the on-line system with the longer-term applicability of the off-line weather-based forecasts.

7360 Efficient simulation of system protections during electromechanical transients. Barretta, L. (ENEL-DSR, Milan, Italy). pp 601-602 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Many electrical and electromechanical phenomena affect system protection performance. In studing protection behavior, it is economical to consider the electrical and electromechanical transients separately, because of their different time scale. System protections simulation during electromechanical oscillations is justified by the need for post-mortem reconstruction of incidents and by the need to check the operation of protection devices in planning studies. The paper describes the main considerations and solutions adopted in order to define a suitable simplified protection model to be taken into account during electromechanical transient simulations.

7361 Effect of load representation on small disturbance stability. Jenner, A. (State Electricity Commission of Queensland, Brisbane, Australia); Outhred, H. pp 603-607 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Computer simulation studies are used to investigate the effect of load representation on power system small disturbance stability, using realistic 2, 3 and 5 generator networks. Loads are simulated by static models with a range of voltage and frequency characteristics, induction motor models of varying complexity, and a first order model to represent aggregated load at a bus. Two types of marginally stable oscillation modes occur, one type involving mainly machine angles, and the other type mainly excitation system states. Constant admittance models given more stable behavior than constant power loads, and the first order model gives adequate representation of mixed induction motor and static loads in most cases.

7362 Simulation of power system dynamics using trapezoidal rule and Newton's method. Hartkopf, T. (Forschungsgemeinschaft fuer Hochspannungs- und Hochstromtechnik (FGH), Mannheim, Germany). pp 608-612 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

To simulate power system dynamics, two sets of equations must be solved simultaneously, a system of differential equations for the dynamic parts of machine models and their control circuits and a system of steady-state equations for the network, the loads and for the algebraic parts of synchronous machine models. This can be done by linearization of the nonlinear network equations by Newton's method, algebraization of the differential equations at once without an interface error. A recommendation for doing this is given. A special technique, combining trapezoidal rule of integration and Newton's method, is described.

7363 Dynamic stability analysis for electrical power systems: frequency domain approach. Sherkat, V.R.; Lo, E.O.; Steding, T.L.; Virmani, S. (Systems Control, Inc., Palo Alto, CA). pp 613-620 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The application of multiple-input, multiple-output (MIMO) stability techniques to the problem of dynamic stability in electric power systems is discussed. The general form of power system equations is presented, and the problem of dynamic stability is de-

scribed. Next, general feedback structures representing the linearized power system are developed with the objectives of maintaining sparsity of the system equations and separating the effects of operating point and/or parameter variations. The application of available results in stability theory to these feedback structures is discussed.

7364 **Optimization of the electric power systems dynamics by emergency command of the generator's excitation.** Iliev, S.; Vassilev, H. (Nippies Energoproect, Sofia, Bulgaria). pp 629-630 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A method for optimization of the electric power system dynamic behavior is substantiated. A stabilizing signal by the sign of the generator's rotor absolute sliding is introduced into the law of actuating the generator's excitation. The investigations are made in some large electric stations in the system of P.R. of Bulgaria, including electric mains of 400, 220 and 110 kV.

7365 **Static stability of the synchronous generators in a regime with diminuated reactive power and in underexcitation.** Iliev, S.; Stanchev, S. (Nippies Energoproect, Sofia, Bulgaria). pp 631-632 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The influence of the quick-acting exciters, the automatic regulator of excitation, the working conditions and the position of the synchronous generators in the electric power system on their stability in a regime with diminuated reactive power and in underexcitation is estimated. It is shown, that the balancing on the active power in the synchronous generators' working area considerably influences the sensibility of the statical stability areas, diminuating the generating reactive power.

7366 **Transient stability analysis of multimachine power system with automatic voltage regulators via Lyapunov's direct method.** Kakimoto, N. (Univ. of Hiroshima, Japan); Hayashi, M. pp 633-640 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Lyapunov's direct method is applied to a multimachine power system in which generators are installed with automatic voltage regulators. The automatic voltage regulator and the thyristor exciter are represented by the third order transfer function. The stability of the power system is checked according to a generalized Popov criterion. The criterion guarantees that the system is stable if the gains of the voltage regulators are lower than certain values. A Lur'e type Lyapunov function is systematically constructed with the method proposed by J.L. Willems. The obtained Lyapunov function is applied to a transient stability analysis of a 10-machine power system. The direct method yields results which are very close to those obtained by simulations.

7367 **Computer models for the analysis of ac-dc power system disturbances.** Arrillaga, J. (Univ. of Canterbury, New Zealand); Arnold, C.P.; Heffernan, M.D.; Turner, K.S. pp 641-648 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The extent of applicability of quasi steady state and detailed transient converter models is discussed in the context of ac/dc system disturbances. An interactive approach is proposed which involves the simultaneous use of transient stability and transient converter simulation programs, the latter being replaced by a quasi steady state converter representation upon fault recovery.

7368 **Application of Lyapunov method and its generalization to the analysis of transient stability electric power systems.** Strakhov, S.V.; Vaiman, M.Y. pp 649-656 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The possibilities of Lyapunov direct method for the computation of dynamic stability of complex electric power systems are stated in the report. Lyapunov functions are built for the models which take into account energy dissipation, mechanical damping, asynchronous moment of generators, automatic speed controllers.

7369 **Calculations of the static limits for multiply fed systems.** Pundt, H.; Pietzsch, H. (Technische Univ. Dresden, Germany). pp 657-661 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

If permissible parameter limits are exceeded, especially in the voltage control circuits of synchronous machines, then oscillation phenomena of all electrical and mechanical (rotor angle) quantities will be caused mainly in the vicinity of the feeding station. The aim of this paper consists in calculating the static stability limits within the coordinates of the voltage control for multiply fed networks on the basis of the complete system of Park's equations for synchronous machines (provided the frequency is constant) and the fundamental equations of the D-separation.

7370 **Improving dynamic equivalents for transient stability analysis: application studies in Brazil.** Franca, A.M.; da Costa, V.F.; Monticelli, A. (UNICAMP, Campinas, Brazil). pp 662-668 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The experience obtained using the coherency-based dynamic equivalencing procedure on a Brazilian interconnected system is described. Some modifications in the basic method have been introduced, e.g., applying boundary matching to attach the external equivalent to the retained system without using phase-shifters to group coherent generators on a common bus. The procedure has been successfully validated on several networks, including a 20,000 MW Brazilian interconnected system at 138/230/500/765 kV voltage levels and composed of 320 buses, 44 generating-buses and 470 branches. A system size reduction of about 3:1 has been achieved.

7371 **Simple criterion for the numerical evaluation of a multimachine stability region.** Di Caprio, U. (ENEL, Milan, Italy); Scarpellini, P.; Robo, K. pp 669-676 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The problem of the numerical determination of the closest unstable equilibrium represents the main practical difficulty for determining the stability region of a multimachine system using the Liapunov method. This difficulty is overcome by following an entirely different approach to compute the limit value V/sup L/ which identifies the boundary of the stability region. Also, a-posteriori can be determined, i.e., after the computation of V/sup L/, the closest unstable equilibrium.

7372 **Transient stability and movement of system eigenvalues.** Ma, T.; Janischewskyj, W. (Univ. of Toronto, Ontario). pp 682-687 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The stability of a synchronous machine under large disturbances is examined by tracking movement of eigenvalues of differ-

ential equations, describing the system linearized at each transient operating point, as the state vector moves in time in the state space. The method uses a numerical integration technique to provide operating points for the linearization and calculation of matrix eigenvalues. With a judicious choice of state variables, a relationship between eigenvalue movements, state variables and transient stability of the system is achieved. The relative or absolute transient stability is reflected in the movement of critical eigenvalues around equilibrium positions in the complex plane.

7373 **Investigation of steady-state stability and qualitative characteristics of transient processes in interconnected multimachine power systems using frequency response methods.** Grusdev, J.A.; Lediankin, D.P.; Litkens, I.V.; Bratolyubov, A.A.; Prachin, B.J.; Pugo, V.I.; Tereschko, L.A. pp 688-693 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Steady-state instabilities or poorly damped transients are quite possible in interconnected multimachine power system due to the variety of their structures and wide range of operating conditions as well as to uncoordinated action of AVRs which are installed on most power stations. In this connection the following problems are of importance: evaluation of qualitative characteristics of transients (natural oscillation frequencies and damping rate of electro-mechanical oscillations) in a power system; identification of the optimal control laws and coordinated AVRs adjustments in order to ensure steady-state stability for all possible operating conditions of the system as well as high quality of transient processes; and determination of steady-state operating limits in the system. The results of the investigation of these three interconnected problems are presented.

7374 **Steady-state stability analysis of controlled power system with the help of digital computers.** Venikov, V.A.; Karasev, E.D.; Stroev, V.A. (Moscow Power Engineering Inst., USSR). pp 694-701 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An effective algorithm for the calculation of the steady-state stability areas with the help of D-separation method and Mikhailov criterion is discussed. The algorithm used the system characteristic matrix in the form of nodal admittance matrix and allows for the stability analysis for standard and reduced Park's equations. The application of hypercomplex numbers, Kron's matrix inversion formula and sparse matrix programming made it possible to take advantage of all the symmetry properties of the nodal admittance matrix together with the network topology.

7375 **Newton's method for the computation of optimal output feedback gains and its application to power systems.** Zhou, X.X. (Electric Power Research Inst., Beijing, China). pp 705-709 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A new algorithm which is based on Newton's method has been proposed for calculating optimal output feedback gains in this paper. The formulas and procedure of the proposed method are described in detail. To show the applications and the performance of this method, an example of a simple power system is given.

7376 **Array processor applications in power system planning and operation.** Lamont, J.W.; Iveson, R.H. (Electric Power Research Inst., Palo Alto, CA). pp 710-717 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A description of past, present and future parallel processing activities of the Electric Power Research Institute (EPRI) is presented. Descriptions of individual projects, their status, and resultant publications are included.

7377 **Accelerated recovery for pole slipping by selective quadrature boost-buck control.** Arnold, C.P. (Univ. of Canterbury, New Zealand); Arrillaga, J.; Duke, R.M. pp 718-725 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A novel method of improving the rate of recovery for pole slipping of a generator is proposed. This is achieved by using a thyristor controlled quadrature voltage injection transformer operating in conjunction with the generator's speed governor. A transient stability program is used to demonstrate the advantages of the control scheme.

7378 **Strategy and digital realization of joint control for digital governors in a multi-unit power station.** Malik, O.P. (Univ. of Calgary, Alberta); Hope, G.S.; Abou-el-ela, M.S. pp 726-730 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A scheme for joint control of generating units controlled by digital speed governors in a multi-unit power station is described. The proposed control scheme has a hierarchical structure decomposed into two levels. Digital simulation studies on the proposed scheme show that it is capable of operating the station generating units in both independent and joint control modes and that it can perform unit transfer between these two modes of operation without causing any disturbance to the power system. The unit and supervisory level controllers have been implemented using a microprocessor and a minicomputer respectively. Maintenance of successful communication between the unit controller and the supervisory controller was also demonstrated in tests.

7379 **Systematic computational procedure for determining the parameters of power system stabilizers for multimachine system.** Doraiswami, R.; de Souza, J.R.B.; Soares, J.M. (Universidade Federal de Santa Catarina, Electrosul, Brazil). pp 731-735 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A systematic computation algorithm for the determination of the parameters of the power system stabilizers (PSS) for a multimachine is represented by a constant voltage behind the subtransient reactance model. The system model includes the detailed representation of the voltage regulators, the voltage the power and the frequency transducers, and the hydraulic oscillation frequency rejection filter. The design of the PSS is posed as a problem of positioning the eigenvalues of the overall closed loop system matrix in some region of the complex plane such that desired dynamical response is obtained.

7380 **Influence of static compensators on transient stability.** Nelles, D. (AEG-Telefunken, Frankfurt, Germany). pp 736-743 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

By means of static compensators it is possible to vary the reactive power distribution in a system very rapidly. It is shown how the transient stability limit is influenced by such a compensator and to what extent a system damping can be gained. A set of equations for the determiation of the essential characteristic data is given as well as some simulation examples.

7381 Optimal control of transients in electrical power systems using a controlled reactive power source. Tawfik, M.A.H. (Ain Shams Univ., Cairo, Egypt); Saleh, F.A.; El-Metwally, M.M. pp 744-745 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The ultimate capabilities of a reactive power source composed of parallel controlled reactors and series controlled capacitors to control transients in a power system have been shown. The optimal control of reactors and capacitors has been obtained for different loading conditions and different control-ranges at different prefault percentages of series compensation. A nonlinear third order model of the system has been used with a quadratic performance index of the system state variables and control signals. The Maximum principle of Pontryagin has been utilized to formulate the optimal control problem.

7382 Use of a special purpose data acquisition system and of sophisticated simulation techniques for the reconstruction of a real incident in the ENEL power system. Bruschi, G. (ENEL, Rome, Italy); Marconato, R.; Sapora, D.; Scarpellini, P. pp 749-756 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

For several years ENEL has installed in very important stations of its hv network a special purpose data acquisition system which detects anomalous perturbations and records the corresponding electromechanical transients. ENEL also developed a set of analysis methods and digital programs for the system behavior studies. The methodology of the reconstruction of incidents and their application to a widespread and complicated incident which occurred in the ENEL power system are described.

7383 Blended transient/mid-term simulations with automated output analysis. Gelopulos, D.; Lightfoot, S.; Converti, V. pp 757-764 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Transient stability studies by digital simulation have evolved rapidly during the last 15 years. During the last few years the scope of such programs has been broadened considerably and the hardware/software cost ratio has been rapidly vanishing. The new priorities for stability programs have been addressed by the Electric Power Research Institute. A digital computer stability program with extended simulation time capability, automated equivalence methods, increased flexibility and automated output data analysis aids is being composed and tested. The salient features of this research program are discussed. A few comments are made regarding the implications of parallel processing computer organizations to this research.

7384 Assessment of power system dynamics for medium and long term studies. Bahgat, A.; El-Metwally, M.M. (Cairo Univ., Egypt). pp 765-767 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A digital program is developed for the assessment of the dynamic performance of large scale power systems during medium and long term periods. Major components of power systems are simulated such as synchronous generators, loads, turbines, boilers, exciters and the associated control systems. Owing to the discrepancy between the study period, the small time constants of some system components and the suitable integration interval, a multilevel integration procedure is adopted in order to minimize the computation time.

7385 Decentralized load-frequency control of interconnected power systems. Hiyama, T. (Kumamoto Univ., Japan); Suyama, T.; Hayashi, M. pp 768-772 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A new method of designing decentralized load-frequency controllers for interconnected power systems is presented. In this method, the interconnected multi-area power system is divided into subsystems, each of which contains one area and a dynamic equivalent in a simplified form of its external area. The decentralized control law for the study area is introduced by using a pole-assignment technique from the mathematical model of the subsystem which corresponds to the study area. The proposed method is applied to the longitudinal interconnected 4-area system.

7386 Identification and control of the mid-term dynamic behavior of electric power systems. Bongers, C. (Vereinigte Elektrizitatswerke Westfalen AG, Dortmund, Germany); Grebe, E.; Handschin, E.; Haubrich, H.J. pp 773-780 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

For power system control the mid-term dynamic behavior, i.e., the time range between one and thirty seconds is of great importance. Some typical contingency situations requiring dynamic studies are described. The problem of identifying power plant models using measured data during emergency situations is also addressed. Since such situations are rare, staged tests are necessary to obtain relevant data. Particular emphasis is given to the turbine-speed control model since it affects the mid-term dynamic behavior of the power system very much. The improvement of the mid-term dynamic response of the power system is also discussed. Using systematic control design procedures yields a reduction of power plants stress and a better frequency behavior.

7387 Applied investigation of the control behavior of different power systems by simulation studies and measurements. Welfonder, E.; Lampert, A.; Heilemann, F.; Schmieg, M. (Univ. of Stuttgart, Germany). pp 781-794 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

For the investigation of long and middle term dynamic problems two comprehensive nonlinear dynamic power system models - describing the interaction of the individual components such as steam boilers, turbines and generators including their controllers, frequency and voltage dependent loads as well as the transmission lines - have been developed and applied to different power systems. A survey of the structure of the developed simulation models, the evaluation of power system parameters, the testing of the power system models and about carried out simulation studies is given.

7388 Simulation of electromagneto-mechanical transients in power systems. Oswald, B.; Pundt, H.; Siegmund, D. (Technische Univ. Dresden, Germany). pp 795-799 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The transient phenomena are explained for conditions where the electrical, magnetic and mechanical variables influence each other so strongly that simplifications by neglecting one of these reactions, e.g., in the first or later time range, are not possible in modelling. Short circuits, load shedding, circuit wiring, self excitation and asynchronous operation are examples of electromagneto-mechanical transients. On the basis of state representation, a mathematical model is presented for their computation.

7389 Unsatisfactory system voltages near the operating range. Brown, H.E. pp 807-810 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Previous investigators in the area of multiple solutions have concentrated their efforts in determining the number of independent solutions that are possible for a power system. Identification of solutions close to the operating voltage range has been of minor interest. This research is only concerned with the determination of buses, that may have a solution close enough to the operating range to pose a threat to the integrity of the system.

7390 New load flow calculation for contingency analysis. Udo, M.; Sato, M.; Nishimura, K. (Toshiba Corp., Tokyo, Japan). pp 811-818 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper relates to a load flow method developed for the analysis of power system under abnormal conditions caused by generator and/or load shedding and system separation which result in unbalance between generation and consumption. Although the method developed is principally based on N-R method, the key points of the method are connection of slack node to one of the generator terminal in each island through reactance and adequate adjustment of power flow in the slack node to be zero. The algorithm of calculation with some numerical examples are shown and proved that additional computing time is negligibly small. The method may be applied to security assessment and power system simulator.

7391 Multisolutions for load flow problem of power system and their physical stability. Sekine, Y.; Yokoyama, A. (Univ. of Tokyo, Japan). pp 819-826 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A method is proposed which always gives convergent load flow solutions or more precisely real-valued solutions if they are physically feasible and complex-valued solutions if not. The proposed method makes it possible to derive very close load flow solutions very successfully for ill-conditioned or heavily loaded power system. Physical stability of each solution obtained is discussed and it is suggested that it is indispensable to take into account the power-voltage characteristics of load and response characteristics of controller to test the voltage stability.

7392 Causes, effects, and correction of off-nominal voltage conditions on the bulk power system. Iveson, R.H.; Lamont, J.W. (Electric Power Research Inst., Palo Alto, CA). pp 827-834 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A discussion of the causes, effects, and correction of off-nominal voltage conditions on the electric bulk power system is presented. Some of the problems and solutions of modeling off-nominal voltage conditions are identified and some heuristic limits for degraded ehv operations are provided. Additional research required in the areas of load modeling and system analysis of off-nominal voltage conditions is identified.

7393 Application of a new analyzing program for hvdc systems to connected ac voltage instability problems. Nakano, S. (Electric Power Development Co., Ltd., Tokyo, Japan). pp 835-838 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The solutions of the transient analysis program for power systems including hvdc systems were not so reliable because of constraints from both hardware and software, that is, constraints in capacity of computer and application of subprogram. Two programs were developed. One aims mainly at dc circuit transient problems analysis, the other mainly at ac/dc systems one. These newly developed programs provide much more effective analysis by means of development and application of general purpose subprograms which make more realistic analysis of the phenomina. The latter program taking the Hokkaido-Honshu hvdc Link as an example is shown.

7394 Numerical determination of the stationary operating points in power networks. Nour Eldin, H.A.; Lerch, E. (Univ. of Wuppertal, Germany). pp 839-844 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A new algorithm was developed which permits selective determination of all existing real solutions of the power equation. The algorithm is based on decoupling the power equation for each node. The power equation has at most two real solutions in reference to other nodes. Through an iterative procedure one can selectively steer to the real solution of the equation. Another advantage is the determination of a load reserve factor for each node. Controlled load dropping depending on the load reserve factor can be achieved.

7395 Structure of power network voltage profiles. Laughton, M.A. (Queen Mary Coll., London, England); El-Iskandarani, M.A. pp 845-851 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A theoretical analysis is made of steady-state nodal voltage profiles in power systems under steady load. It is shown that the structure of the critical eigenvector corresponding to the eigenvalue of least modulus of the nodal admittance matrix is of special importance and an eigenvalue-busbar association is suggested.

7396 Simplified technique to estimate hvdc operating possibility. Uemura, K.; Iyoda, I. (Mitsubishi Electric Corp., Kobe, Japan). pp 855-861 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Dc converters are vulnerable to ac line fault. A simplified estimation technique of commutation failure under ac line fault conditions is presented. The results are checked by detailed simulation in a model power system. From this estimation, it is concluded that this method is effective for evaluating the rough outline of the relationship between an ac line fault and the commutation failure of dc converter, and also concluded that commutation failure is caused uncertainly at the boundary zone between the commutation possible area and the impossible area. Therefore, the behavior of dc converter under such condition should be evaluated with some statistical methods.

7397 Stability improvement by static phase shifting or tap changing transformers. Glavitsch, (Swiss Federal Inst. of Tech., Zuerich); Baker, R.; Gueth, G. pp 862-869 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Static phase shifting and tap changing transformers are compared with series and shunt compensators for stability improvement. A simple control algorithm for a static phase shifting transformer is developed. For small deviations about the operating point, the control is nearly the stochastic optimal control. Yet for large deviations, the response is close to time optimal and results in good first swing characteristics. The algorithm is tested via simula-

tion, deliberately using a different model for the power system than was assumed in developing the control algorithm.

7398 **General model for the calculation of induced noise from electric railroad operation.** Hansen, J.R. (Technical Univ. of Denmark, Lyngby). pp 870-877 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The analysis of electromagnetic noise from electric railroads is impeded by the rather complex structure of the supply system. The application of booster transformers and return conductors further complicates the situation. In order to analyze different supply systems in connection with different types of traction techniques the Electric Power Engineering Department of the Technical University of Denmark in cooperation with the Danish State railways has constructed a general model allowing for the treatment of booster transformers, too. The major part of the model was checked through extensive field measurements and satisfactory accuracy was found.

7399 **Exact and optimal representation of boundary networks.** van Amerongen, R.A.M.; van Meeteren, H.P. (Delft Univ. of Tech., Netherlands). pp 878-879 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A generalization of the well-known Ward-type external system equivalent for loadflow studies is described. Special attention is given to the representation of the reactive power response of the external system and its equivalent. Like the extended Ward equivalent, the generalized one also requires some information exchange. The magnitude of this exchange depends on the number of boundary nodes. The performance of the new generalized external system equivalent appears to be very satisfactory in off-line simulations. In all situations the results were more accurate than the ones obtained with the extended equivalent.

7400 **Simulation of fast transients in hvdc links and comparison with field tests.** Chiu, B.C. (Edmonton Power, Alberta); Dommel, H.W. pp 880-887 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The successful application of hvdc transmission links requires correct predictions of the performance of the dc link and of the ac system to which it is connected. To simulate these phenomena with digital computers, converter stations must be modelled in more or less detail, depending on the type of study. This paper discusses the development of a converter model for the simulation of fast transients with a detailed representation of the converter bridge circuits and of the valve ignition control. Simulation results are compared with field measurements conducted on the Pacific Intertie in connection with dc circuit breaker tests. The converter model is useful for steady-state analysis as well.

7401 **Digital program for the evaluation of mutual electromagnetic and electrostatic inductions in transmission lines.** Invernizzi, A. (ENEL, Milan, Italy); Lunelli, M.; Manzoni, G. pp 888-893 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The report describes a computational code specially set up at ENEL for the study of mutual electromagnetic and electrostatic induction in a large number of electric power lines. The physical model used for representing the phenomenon, the mathematical process, and lastly, a typical application are shown.

7402 **Computer simulation of the ac corona effect above the critical gradient.** Correia de Barros, M.T.; Borges da Silva, J.F. (Centro de Electrotecnia da UTL, IST, Lisbon, Portugal). pp 894-899 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A simulation algorithm using an eulerian description of the space charge limited ambipolar ion flow generated by ac corona discharge is presented. Results for air in a cylindrical coaxial electrode configuration regarding losses and excess capacitance are given and compared with experimental results found in the literature. The possibility of using the method to simulate charge injection under double exponential impulse voltage waveforms is demonstrated for the range of rise times used in switching surge applications. To account for the known properties of the corresponding Q-U diagrams a new parameter, the space charge injection radius, is introduced and given a tentative physical interpretation.

7403 **Transformer model for electromagnetic transients programs.** Stein, B. (Forschungsgemeinschaft fuer Hochspannungs- und Hochstromtechnik, FGH, Mannheim, Germany). pp 900-904 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

To study the mutual influence of transformer in rush currents and feeding system, the Electromagnetic Transients Program written by Dommel in a version used at the University of British Columbia has been extended by a transformer model, which takes into account the magnetic core behavior. The nonlinear equations of winding currents and voltages are implemented into the set of nodal equations of the transients program. The nonlinear part of the system is solved iteratively within each time step. Some test cases have been computed. The results agree with given examples.

7404 **Computation of controlled rectifier in power systems.** Becker, G. (Isar-Amperwerke AG, Munich, Germany); Groetzbach, M. pp 905-909 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Iterative and direct methods are presented for the computation of rectifiers in the regular dynamic mode. In part I, nodal analysis is applied, the difficulties which occur are explained and a solution method with an example is given. Following, state variables are applied for the rectifier part and both methods are coupled. The low-frequency dynamics of rectifier circuits are directly determined in part II, using sample system methods. This way permits the calculation of the eigenvalues of the power system with controlled rectifier. Therewith, the dynamic behavior of the first harmonic and electromechanical transients can be estimated.

7405 **Operator's loadflow and contingency evaluation.** Goudie, D.B. (Brown Boveri & Cie, Baden, Switzerland); Grafoner, P.; Grundhoefer, K.H. pp 910-914 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Operator's Loadflow and Contingency Evaluation as part of Power Application Software within an on-line computer based power system operation control and operating planning system are presented. For useful operation all the physical and operating restrictions of the system components must be modelled. The techniques used and the significant data requirements are discussed.

7406 Short-circuit calculations using matrix modification techniques. Gross, G.; Hong, H.W. (Pacific Gas and Electric Co., San Francisco, CA). pp 915-919 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A generalized solution for solving short-circuit problems is presented. Faults or combination of faults and their associated line outages are considered as modifications to the nodal admittance matrix. Using matrix modification techniques and making detailed use of the structural properties of the admittance and the modification matrices, we developed a computationally efficient scheme to determine the effect of the modifications. Short circuit studies involving any fault type or combination of fault types and the ensuing protective actions can be solved using this approach. The effect of mutual couplings between lines causes no complication. Solutions of very large networks can be handled. Test results on several systems subjected to different fault types are given.

7407 Simulation of non-linearities with a hybrid computer. Wessnigk, K.D.; Voelzke, R.; Haase, C.; Wilhelm, K. (Coll. for Electrical Engineering, Zittau, Germany). pp 920-921 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Non-linearities have to be taken into account in the case of calculation of ferroresonance in house-service installations, if a transformer is switched on and also in many other cases. The paper deals with a proposal for solving of these problems by using a hybrid computer consisting of an analogue computer for simulating of non-linearities, a transient network analyzer and a digital computer in on-line operation.

7408 Package of ENEL digital programs for off-line dynamic security studies. Baratella, P.; Castrovilli, M.; Marconato, R.; Scarpellini, P.; Spelta, S. (ENEL, Milan, Italy). pp 922-923 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In the recent years the studies dealing with the dynamic behavior of a multimachine electric power systems have reached a very important role. Because of this the ENEL's experts have designed and developed an integrated package of digital programs (both for planning and operation problems), briefly described in the paper, which allow to perform several dynamic security studies relevant to the power system behavior both for large and for small perturbations.

7409 General algorithm of currents and voltages for electrical systems, containing phase shifting elements. Fazilov, K.F.; Nasirov, T.Kh. pp 924-935 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The problems of calculating the symmetric and asymmetric conditions of electrical circuits containing phase-shifting elements on the base of symmetric components only are considered. The analysis is limited by the linear models of three-phase electric circuits, consisting of symmetric elements and fed by symmetric sources of e.m.f. In this case of asymmetric conditions due to shunt or series and single or multiple complex asymmetry, only main harmonics of currents and voltages are considered.

7410 Quasi-stationary and dynamic load flow for power system simulation. Reichert, K. (Swiss Federal Inst. of Tech., Zurich); Hammad, A. pp 936-943 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Load flow simulation is a standard tool in power systems planning, operation and training. Thereby the classical load flow model with PV, PQ and slack nodes is not appropriate if the balance of active and reactive power cannot be maintained by an infinite source. Frequency, voltage, inertia, control and protection effects have to be incorporated. The paper defines various levels of loadflows, representing quasi-stationary and long term dynamic problems and describes solution methods and programming structures. The load flow system presented is modular, i.e., the user can start with classical models, adding more complex ones if necessary. Examples demonstrate the versatility of the approach.

7411 Avoiding ill-conditioned matrices during implementation of arbitrary combinations of simultaneous faults in connection with short-circuit and transient stability studies. Edelmann, H. (Siemens AG, Erlangen, Germany). pp 944-948 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In earlier papers, simultaneous short-circuits in ac systems were simply represented by the introduction of large admittances, which were then transformed into additional transmittances, but these have a pronounced negative effect on the matrix condition. This paper describes a direct, exact method for representing such simultaneous faults. The author develops combined row and column operations on the node admittance matrix, which also prove to be limit solutions to the corresponding eliminations according to Gauss. A relationship with unit annihilators is also pointed out. Row and column operations are shown in tabular form. Also stated are the causes of rounding errors in cases where additional matrices of a high order of magnitude are used. The simultaneous introduction of interruptions no longer poses problems.

7412 Calculation of short-circuit currents in high-voltage systems. Oeding, D. (Technische Hochschule Darmstadt, Germany); Scheifele, J.; Komurka, J. pp 949-956 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

For the short-circuit calculation, particularly at the planning stage, a method is needed without the systems operational values, i.e., without knowledge of the load flow. This approximate method with an equivalent source voltage at the short-circuit location should provide results to the maximum short-circuit currents calculation which lie on the safe side, compared with the exact calculation according to the superposition method. In low-voltage and high-voltage systems up to 35 kV it is advantageous to introduce an equivalent source voltage 1.1 . U/sub n//$\sqrt{3}$ in the event of far-from-generator short-circuits. In high-voltage systems it will be necessary to introduce a reactance correction for power station units if this equivalent source voltage is maintained.

7413 Power plant response identification for on-line system control. Farmer, E.D. (Central Electricity Research Labs., Leatherhead England); Duckworth, S.; Laing, W.D.; Mogridge, L. pp 959-969 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Methods for the on-line identification of the response capabilities of the principal categories of steam power plants are formulated and assessed. It is found that, for system control purposes, low-order turbine-boiler models may be used to effectively describe plant responses. Techniques, based on Kalman filtering and regression analysis, are applied in the identification of the changes in set-points, due to operator action, and the variation of the gain of speed-governing systems, with valve position. Similarly, the behavior of a regulating pressure-governed unit, is found to be accurately represented, by a first order model. Identification algorithms, based

on measurements of frequency, power output and steam pressure, are evaluated.

7414 **Experiences with an on-line-state-estimator having extended functions, applied to a part of the Swiss high voltage grid.** Asal, H.P. (Elektrizitaets-Gesellschaft Laufenburg AG, Switzerland); Oesch, F.; Lacoste, B.; Saly, S.; Signer, K.; Fruehauf, K. pp 970-975 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The core of the extended on-line-security based power control system in Laufenburg is a new state estimator with an on-line technique for network topology determination, an observability function and bad data suppression. These power application software functions have an interface to the telemetering system a real-time-data base with extended functions performing as an interactive man-machine-interface to the operator. These functions are running on-line on a process computer system consisting of a front end and a main computer.

7415 **Identification of network topology.** Klos, A.; Dobrzanski, A. (Computer Centre of Power Systems, Warsaw, Poland). pp 976-981 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The paper deals with network solution problems in which branch voltages and currents are known whereas network configuration is partially unknown and to be found. The theoretical considerations and a solution method of the problem are presented. The method is based on a matrix model in which elements of network incidence matrix are the unknowns. The technique of generalized inverses of matrices has been employed. An algorithm of solution is presented and an illustrating example is shown.

7416 **State estimation and unobservable networks.** Broussolle, F.; Le Roy, A. pp 982-988 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The picture of the power transmission system given by a state estimation model is limited to its observable parts. Many areas are not included in it, namely: interconnected neighboring networks, the measurements of which are now known; subnetworks affected by measurement system failures; and networks insufficiently equipped with measurements. This paper presents solutions used at Electricite de France (EDF) to extend the estimation results to unobservable areas and this, in order that power system simulation models such as security analysis, economic dispatch and voltage optimization still can be used when the entire system, to which they are applied, is no longer completely observable.

7417 **Advanced linear programming techniques applied to power systems state estimation and bad data identification.** Hamam, Y. (Ecole Superieure d'Ingenieurs en Electrotechnique et Electronique, Paris, France); Jussiant, C.; Gheury, J.; Trecat, J. pp 989-996 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Most of the papers already published on state estimation use the weighted least-squares (WLS) approach or some of its variants. An alternative consists in a linear programming (LP) formulation. However, because of the large set of variables and constraints as well as the size of the basis, both the dimension of the matrices and the amount of computations lead to a large memory space and CPU time. Both of these disadvantages can be drastically reduced owing to the use of an advanced linear programming technique associated with an adequate formulation. The method compares well with the WLS approach. Compared with the latter, it presents the following advantages: precision and simplicity of bad data analysis; and insensitivity of the final solution to bad data.

7418 **Identification of dynamic equivalents for power system transient stability studies.** Rudnick, H.; Hughes, F.M.; Brameller, A. (Univ. of Manchester, England). pp 997-1001 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An identification technique to find dynamic equivalents of a power system is reported. It corresponds to an iterative least squares identification using a hybrid Gauss Newton-steepest descent formulation. A deterministic intentional perturbation of the study system is required. Equivalent machine and network parameters are identified and the paper reports on the accuracy of the equivalents when transient stability studies are carried out. The technique provides accurate equivalents, similar to those of the coherency aggregation methods, with the advantage that no detailed knowledge of the external system is required, other than its response to the perturbation. The feasibility of an on-line use of the technique is discussed.

7419 **Nonquadratic state estimation: a comparison of methods.** Falcao, D.M.; Karaki, S.H.; Brameller, A. (Univ. of Manchester, England). pp 1002-1006 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In this paper, a comparative performance study of two nonquadratic state estimators is presented. The first one uses a fast decoupled version of the bad data suppression method which combines numerical efficiency with a capability to eliminate bad data. The second one is based on a recently proposed estimator using linear programming which is also presented in a decoupled formulation. The two methods are compared in terms of the ability to detect and identify bad data, reliability of convergence, time and storage requirements. Results are given for networks of different sizes and characteristics with different metering patterns.

7420 **Exact static state estimation algorithm retaining non-linearity.** Allam, M.F. (Univ. of Riyad, Saudi Arabia). pp 1007-1013 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An ac iterative load flow technique is adopted for solving the non-linear exact state estimation algorithm. The technique makes use of the fact that the estimation equations are a redundant set of quadratic algebraic equations when expressed in Cartesian coordinates. Taylor's expansion of these equations contains terms up to the second order only. The Jacobian matrix and consequently the measurement covariance matrix are constant during the iterative process at their initially computed value. Thus this simple iterative technique reduces the state estimator computational time and core size drastically.

7421 **Algorithm for pre-filtering of gross measurement errors in power system static state estimation.** Doraiswami, R. (Universidade Federal de Santa Catarina, Florianopolis, Brazil). pp 1014-1018 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

An algorithm for pre-processing the measurements so as to detect and identify the gross measurement errors, is presented. The measurements are restricted to be the active and the reactive power flows and power injections. The algorithm consists in choosing a set of variables which satisfy known algebraic equations as the states, estimating these states from the measurements and verifying the estimates for the satisfaction of the algebraic equations. The voltage angle differences and voltage magnitude differences are chosen as the states. The measurement equation is expanded using

Taylor series and a term which is a linear function of the states is retained.

7422 Advanced real-time modelling of the Finnish high-voltage network. Kosonen, H. (Imatran Voima Oy, Helsinki, Finland); Lindstroem, K.; Nilsson, B.; Schubert, J. pp 1019-1026 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A new control system has recently been commissioned for the control of the Finnish national network. Advanced application functions are included in the system facilitating the monitoring and operational planning of the whole power system. This paper discusses objectives and basic methods for the network modelling subsystem, containing programs for network configuration, bad data detection and correction, and state estimation. Some experiences from the implementation, as well as commissioning of these functions are given. Attention is paid to man-machine communication. The presentation concentrates on principles and general design aspects of common interest to both users and suppliers.

7423 Combined state and parameter estimation for electrical power systems. Theil, G. (Technical Univ. of Vienna, Austria). pp 1027-1029 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A formulation of combined state and parameter estimation is presented in which the Jacobian matrix in rectangular coordinates is transformed to a complex shape. This formulation combines the advantages of the admittance matrix method - short computation time and small memory requirements - with the numerical stability of the Jacobian matrix method. To increase redundancy the program was extended to parameter tracking state estimation. For special cases, in which the inaccuracy of parameters is negligible the parameter variables can be restricted to transformers.

7424 Identification of bad data using signs criteria. Pietrzak, F.K. (Centrum Informatyki Energetyki i Energii Atomowej, Warsaw, Poland). pp 1030-1035 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper presents a new means to detect and identify bad telemetry data. Compared with existing methods, additional information utilized from the vector of residuals. A new criterion is proposed which is in the sequence of residual signs. It is shown that signs of the consecutive residuals are related to the signs of measurements to estimate covariance vectors and this fact allows errors to be localized and to establish values of an error and its sign. The use of the described criterion, together with other known criteria, can be used to identify double errors.

7425 New two-level algorithm for large power systems estimation. Van Cutsem, T.; Horward, J.L.; Ribbers-Pavella, M. (Univ. of Liege, Belgium). pp 1036-1037 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The hierarchical state estimation (HSE) method outlined in this note has been tested on the 111-bus Belgian 380, 220, 150 kV system. The results of the numerous simulations concerning the SE aspects themselves have been previously reported. Simulations relative to the bad data problem have also been performed. Due to obvious space limitations their results are not included here. Nevertheless, they ave served to assess the considerations developed above. Various advantages have thus been brought up of the HSE approach over the conventional integrated (ISE) procedure; other advantages inherent in the particular HSE approach considered here over other hierarchical approaches may also be quoted. Among the for advantages are: important gain of computing time (7.88/1.33 sec. in the Belgian system case); reduced computer memory; little spreading of errors from a subsystem to the others and hence easier and faster bad data detection at the first level; and low processing cost. With respect to the latter aspect we may list the following advantages: great independence and flexibility in designing the FSE's; possibility of running the different first-level sate estimations (FSE's) with different frequencies; easy embedding and/or removing of subsystems; small exchange of information needed between the two levels; and high speed of the SSE.

7426 Automated experimental identification of power system components under operating conditions. Hope, G.S.; Malik, O.P. (Univ. of Calgary, Canada). pp 1038-1042 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A technique for the measurement of transfer functions of individual components and overall system under normal operating conditions is described in this paper. The technique relies on the introduction into the system of a pseudo-random binary sequence (PRBS) signal of low level that is unnoticeable at the output terminals of the system under test. The computational technique is basically an analysis in the frequency domain and is particularly well adapted to computer application. The entire test procedure is automated so that the frequency response or poles and zeros of a system under test can be obtained directly.

7427 Power system state estimation: implementation and field performance. Adrian, E.C. (Systems Control, Inc. Palo Alto, CA); Virmani, S.; Bischke, R.E. pp 1043-1047 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The implementation of state estimation is described. The programs necessary to produce a state estimate are functionally characterized, along with an approach for initiating these programs. A discussion of implementation considerations is presented together with experience obtained from three implementations.

7428 State estimator allocation using stochastic load flow. Tamura, Y. (Waseda Univ., Tokyo, Japan); Mori, H.; Inoue, T.; Iwamoto, S. pp 1048-1055 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A new state estimator allocation approach is presented using a stochastic load flow method. First, the stochastic load flow problem is reviewed, which takes into account stochastic variations on specified values in load flow equations. Next, the state estimation problem is outlined, which is considered to be of great importance to carry out reliable power system operations. In order to relate the stochastic load flow problem to the estimation problem, the concept of variance is introduced. The variances of line flows are obtained from the stochastic load flow calculations and they are used to select redundant measurement set for state estimation. The approach is tested with 5 and 14 bus systems successfully.

7429 Bad data reestimation-identification using residual sensitivity matrix. Ma, Z. pp 1056-1060 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In this paper a new bad data identification algorithm is proposed in which the identification process is done by making use of a series of bad data identification objective functions J(b)'s. This method involves only the solution of low order simultaneous linear equations. Practical search technique by local combination can be

used, so that the time of the entire identification process may be greatly shortened.

7430 **Estimation and identification of multiple bad data in power system state estimation.** Xiang, N. (Tsinghua Univ., Beijing, China); Wang, S.; Yu, E. pp 1061-1065 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper briefly describes a new Approach - the Estimation-identification Approach for identifying the multiple bad data in power system state estimation. The method of estimation of bad data, the estimability of suspected data, the correction of state estimate disturbed by bad data and the method of search for suspected data points are presented in the paper. Some of the test results on a model power system are given. This approach can be applied to improve the performance of the current static-state estimators in power systems.

7431 **Parallelism in elimination algorithms for sparse matrices.** Rueb, W. (Technischen Univ. Muenchen, Germany). pp 1069-1077 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The solution of large sparse systems of linear equations by Gaussian elimination appears in all power system problems. If a large number of case studies is to be analyzed or if on-line computers are used, very short computing times are required. This paper deals with methods used to exploit parallelism in Gaussian elimination procedures for multiprocessor systems. Three levels of parallel execution are shown and problems such as mutual exclusion for data access and processor allocation anomalies are discussed. A combined hardware - software engineering approach for linear equation solution is described and applied to the AEP test networks.

7432 **Parallel processing algorithm for fast load-flow and stability calculations.** Narita, S.; Tachiyeda, H.; Omata, K.; Mimura, T.; Kasahara, H. (Waseda Univ., Tokyo, Japan). pp 1078-1085 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A parallel processing algorithm for fast load-flow and transient stability calculations is proposed for both in-house-type multimicroprocessor and computer network structures. Numerical results are given of the simulation runs for sample power systems. The optimal number of subdivisions and cutting boundaries are discussed and an estimate is made for the overall solution time of general power systems. The proposed method compares favorably with similar existing methods with respect to solution time.

7433 **About the search of a right way to use array processors for optimal power flows.** Carpentier, J.L. (Electricite de France, Paris). pp 1086-1092 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In order to apply an on-line optimal power flow in a control centre, an evaluation of the computation duration of such a program in an array processor coupled with a minicomputer was undertaken. This study used a detailed analysis of the computation durations of the various subroutines, results of benchmarks and programming in the parallelized assembly language of an array processor. Even if not very accurate, the results showed the interest of using subroutines written in FORTRAN, compiled without any parallelization and run in the array processor, and not only FORTRAN subroutines in the host computer and parallelized subroutines in the array processor.

7434 **TOPSY-2: a portable real time executive for process control applications.** Jervis, P. (Central Electricity Research Labs., Leatherhead, England). pp 1095-1102 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

TOPSY-2 is a multi-task memory-based executive which has been developed to provide a standard framework for computer based control and instrumentation schemes. It enables a number of programs to run concurrently and communicate with each other and with input-output devices. The software is modular so that individual sets of executive facilities can be selected to suit a particular application. The bulk of the software is written in CORAL, and can be implemented rapidly on any computer with support for CORAL.

7435 **Power flow and transient stability data transfer and conversion.** Lamont, J.W.; Iveson, R.H. (Electric Power Research Inst., Palo Alto, CA). pp 1103-1104 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper presents a brief description of a planned project for a preprocessor to input, check and create a data base for both power flow and transient stability to be developed by the Electric Power Research Institute for use with a variety of programs. Further information will be made available as the project gets underway. It is anticipated that the preprocessor will be expanded to include long-term dynamics data such as automatic generation control data and boiler dynamics.

7436 **Automatic data supply for an on-line network configuration.** Castagnoli, V.; Demartini, G. (ENEL, Milan, Italy). pp 1105-1110 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In the centralized control of a power system, the knowledge of the network electrical configuration is a basic feature. In fact, the control functions more sophisticated than supervision, as state estimation, security analysis, etc., require reliable information about the state of breakers and isolators, and the following network topology, i.e., the set of the electrical busses with their connections. After a brief description of the configurator used in the Power Generation and Transmission control (PGTC) system (actually being set up at ENEL), the authors point out the problems arising when the dimensions of the network to be configurated become very large. A completely automatic method to prepare the relevant data for the on-line data base is presented. It is economical, fast and highly reliable.

7437 **Field experience with a digital relaying system for distribution substation.** Yamaguchi, H. (Kansai Electric Power Co., Inc., Osaka, Japan); Nakano, A.; Sugiyama, T.; Murata, Y.; Jikihara, Y. pp 1111-1118 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Remarkable improvement is expected in the power system control and protection field by using digital techniques based on microprocessors. This paper describes a fundamental scheme and field experience of digital relaying systems for distribution substations. The equipment protection relays for two 77 kV transmission lines and twelve 6.6 kV distribution feeders are described. The system was installed for the field test, and experienced many power system faults but normal relay operation.

7438 **Simulator for the training of power system operators.** Schaffer, G. (BBC Brown Boveri & Cie, AG, Baden, Switzerland); Ebert, K.; Ess, A.; Bissat, O.; Germond, A.J. pp 1119-1124 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A simulator has been designed for the training of power system operators which allows the operator to practice all facilities which are provided in the control center, without interfering with the power system itself. Furthermore, he can be trained to handle emergency situations which will be initiated by a so called event simulator. This training simulator makes full use of the existing software and computer facilities already provided in the dispatch center. The design criteria for such simulator are stated and its module structure is explained. The interactions between the different models and the data flow is described.

7439 **Multi-computer based automated National Load Dispatching System for Hungarian Power System (HALDIS).** Kiss, L. (Hungarian Electricity Board, Budapest); Kubo, T.; Hanke, T.; Hirakouchi, Y. pp 1125-1126 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The National Dispatching Center, NLDC, for the Hungarian Power System came into computerized operation in March 1979, as a multi-computer based system. Of special interest is the adoption of multi-computers (two sets of process computers) with the shared high-speed core memory (global memory) and sophisticated bus structure. The major functions of the system are LFC, EDC, security monitoring, security analysis (postmortem review), daily load forecasting, power system study and basic functions, such as man-machine control, data acquisition control and configuration control.

7440 **Development of a digital directional comparison relaying system and the result of its field experience.** Yamaguchi, H. (Kansai Electric Power Co., Inc., Osaka, Japan); Nakano, A.; Sugiyama, T.; Maeda, K.; Hatata, M.; Yoshida, T. pp 1127-1134 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A microprocessor-based digital system for a two terminal directional comparison relaying with power line carrier was developed and has been installed at the terminals of 154 kV resistance grounded transmission line for field trial. The system encountered 32 cases of transmission line faults and operated correctly for all these cases, which proved the security and dependability for all these cases, which proved the security and dependability of both the hardware and software of the digital relaying system. The application of microprocessors results in not only the compactness of the relaying system less than a half of the conventional equipment but also the easier maintenance and higher reliability due to the automatic test and self-monitoring functions.

7441 **Some statistical evaluations of data types used in grid automation.** Rumpel, D. (Duisburg Univ., Germany). pp 1135-1142 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Twenty-five hundred item-types used in 15 control centers for describing the power system and its operation were collected and compared by name and meaning. The distribution of the probability, by which item-types with the same meaning return in different control centers is derived via model calculations. In general, this probability is rather low. The reasons are discussed.

7442 **Application software for control and planning in power system dispatch centers.** Fruehauf, K. (Brown, Boveri & Co., Baden, Switzerland); Signer, K.; Grafoner, P. pp 1143-1151 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The paper presents the structure of an integrated software system for operation-control and operation-planning in power generation and distribution control centers. The complete integration of the power application software (PAS) renders a uniform communication with the control, monitoring and (short/medium term) planning functions. Concentrating on the comprehensive PAS package, the paper describes the functions available in different console modes and gives a classification of the corresponding software modules and data sets. A further topic is the database management system applied in the power control software system.

7443 **Potential applications of phase angle and rotor angle measurements.** Bonanomi, P. (Brown, Boveri & Co., Ltd., Baden, Switzerland). pp 1152-1153 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The measurement of phase angles and rotor angles can be performed economically by using accurate clocks at the locations of the measurements. This principle has been used in a field experiment in order to investigate the practical aspects of such a measuring technique. A number of applications may be suggested for these measurements. In power system monitoring, the phase angle measurements may be used as a complement to state estimation. In control applications, phase angles and rotor angles represent valuable information about the state of the dynamical system. When evaluating such applications, the limited reliability of certain elements such as data links and clock systems must be taken into account, however.

7444 **Development of the computerized power system control in Hungary.** Wierdl, K. (Hungarian Electricity Board, Budapest); Benko, I.; Szilagyi, A.; Szaniszlo, M.; Hadik, Z. pp 1154-1158 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

As the first stage of computerization of system control a Hitachi-made double system has already been implemented in our National Dispatching Center (NDC). The computerization of the lower levels of the control hierarchy is being completed in the next years. The principles of this development are in line with the practice followed all over the world. The scheduling and methods of implementation, however, are highly individualized by our specific technical-economical conditions. The paper provides information about the general setup of the control system and some problems encountered in the course of implementation.

7445 **Display management systems for energy control.** Stagg, G.W. (Stagg Systems Inc., New York, NY). pp 1159-1163 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The video display subsystem is an essential component of an energy control system for the operation of a power system. It is one of the principal communication links between the system operator and control system. The support program facilities that provide for the use of the video display subsystem must be designed to provide a Display Management System that is easy to use as well as flexible and responsive to the operational needs of the energy control system. The overall requirements of a Display Management System necessary to meet these goals are presented.

7446 **Systems design approach for automation systems.** Vitins, M. (Brown Boveri Research Center, Baden, Switzerland). pp 1164-1171 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In the design of industrial control systems an overwhelmingly large number of solution techniques and realizations are employed. This paper discusses the use of an abstract model of the controlled and controlling system as a basis to derive the requirements which any solution must satisfy. The research outlined in this paper is aimed at understanding the nature of complex real-time software systems, with particular reference to power system automation, and at developing a disciplined approach to specifying requirements.

7447 **Implementation of computers and CRT displays in monitoring power system operation.** Cheng, C.B. (Najing Automation Research Inst., China). pp 1172-1176 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper describes a computer system with color CRT displays which meets the requirements for the monitoring and control in real-time operation of a power system. This system has been implemented in the Beijing Electric Power System Control Center for two years and proved to be viable, reliable and practical. The design features with respect to computer hardware, data acquisition system, CDT interfact, CRT display, man/machine interface and software are presented. For satisfying further functional expansion and increasing reliability of the system, a dual computer system will be installed in 1981. This paper introduces its design concepts.

7448 **Dynamics and control of large scale systems.** Dillon, T.S. (Monash Univ., Clayton, Australia). pp 1179-1190 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

In this paper, the problems of modelling the dynamics of large scale systems in an appropriate fashion and of developing control strategies for control of such systems are discussed. A survey of the relevant literature is carried out and a critical evaluation is presented. Its pertinence to power system problems is highlighted.

7449 **Simulation of magnetic hysteresis by algorithms based on circulation rules.** Ivanoff, D. (Univ. S. Paulo, Brazil). pp 1204-1208 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A conceptually simple and practical scheme for calculation of arbitrary paths in the B-H plane is described. Capability to close a minor loop and then resume previous path is included. The scheme is based on a set of circulation rules which are shown to be flexible enough to assure compliance with most experimentally observed effects. Magnetic characteristics are introduced through coordinates of selected points in the B-H plane, remaining values being obtained by interpolation. The intended applications of the method are in simulation of electromagnetic transients in high voltage networks in presence of iron cored inductors and transformers.

7450 **Power system state estimation in hierarchical control structure.** Bogdanov, V.A.; Liseev, M.S.; Unger, A.P. (Moscow Power Engineering Inst., USSR). pp 1209-1214 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

The algorithms are considered for the development of a set of hierarchical steady-state power system models from the measurements of power system conditions. The models are intended for both regional and interconnected power systems as well as for power pools. The set of models realized as computer programs provides for the analysis of measurement errors, bad data detection, power system state estimation, development of detailed and reduced models of power system operating conditions for each hierarchial level. The estimates of power system state are also obtained in case of islanding due to lack of measurements. The models can be used for power system operation and planning.

7451 **Application of distributed array processing to cutset identification.** Saleh, A.O.M. (Univ. of Basrah, Iraq); Laughton, M.A. pp 1215-1221 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Cutset evaluation forms an important part of the reliability analysis of a power system. Most of the publications in this field are suitable with conventional series processing. This paper shows how distributed array processing can be used more efficiently to deduce the minimal paths and their cutsets.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 7571, 7653, 7667, 7753

7452 **(PAEC(C)VI-A—81004) Philippine Atomic Energy Commission and its training program.** Ragot, T.A. (Philippine Atomic Energy Commission, Diliman, Quezon City). 1981. 7p. (CONF-8104179—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82703402.

From 3. Southern Philippines Physics Society convention; Iligan City, Philippines (2 Apr 1981).

This article briefly but comprehensively enumerates the functions and responsibilities of the Commission with emphasis on its local and overseas training program. It emphasizes the significance of these programs in meeting the manpower need of the country especially with the construction of the first nuclear power plant.

7453 **(PAEC(C)VI-B—79012) Recruitment training and licensing of operating personnel for nuclear power plants.** Palabrica, R.J. (Philippine Atomic Energy Commission, Diliman, Quezon City). 1979. 14p. (CONF-7911182—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82703403.

From IAEA regional training seminar on operation and maintenance of nuclear power plants in developing countries; Kalpakkam, India (5 Nov 1979).

This article covers the step-by-step and most rigid recruitment, training, and licensing procedures undertaken in the selection for personnel involved in nuclear power plant operations. These procedures are true to all countries. However, for developing countries such as the Philippines, a bachelor's degree may be required as compared with the U.S. wherein a high school diploma is the minimum requirement. Because of the complexity of a nuclear facility, the work will require highly capable individuals with mature judgement who can render correct decisions even under highly stressed conditions. Thus during the selection and recruitment of applicants for the operator position, they are not only given aptitude tests but are also subjected to a series of psychological examintions. Once they are accepted, they are made to undergo a comprehensive and in-depth training to ensure that they will be capable of operating the nuclear power plant safely and effectively. Finally, those prospective operators have to pass licensing examinations in order to prove their competence and skills. Retraining programs follow after their training to maintain their skills.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 7507, 7539, 7551, 7576, 7594, 7597, 7605, 7610, 7612, 7621, 7622, 7623, 7624, 7628, 7629, 7631, 7644, 7652, 7655, 7661, 7663, 7752, 7917

7454 **(DOE/ET/34031—8) BWR Fuel-Bundle Extended-Burnup Program: end of Cycle 7 fuel-bundle examination at Monticello Nuclear Generation Plant.** Habermeyer, J.A.; Ogawa, S.Y.; Ingvoldstad, J.R. (comps.). (General Electric Co., San Jose, CA (USA). Nuclear Fuel and Special Projects Div.). Jul 1982. Contract AC02-80ET34031. 47p. (GEAP—22160). NTIS, PC A03/MF A01. Order Number DE83003102.

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This report describes the work performed, data obtained and visual obeservations made during the first examination of high burnup fuel bundles as part of a joint United States Department of Energy (DOE), General Electric Company (GE), Northern States Power company (NSP) BWR Fuel Bundle Extended Burnup Program. Four 8 x 8 reload fuel bundles which had been operating at the Monticello Nuclear Generating Plant since the beginning of cycle 3 had each attained an average burnup of 33,800 MWd/MTU. Three of the fuel bundles were examined during the reactor refueling outage at the end of cycle 7. The fourth bundle was discharged and examined after the refueling outage, including the removal of three spacers, the water rod and twelve fuel rods for subsequent hot cell examination.

7455 **(DOE/ET/35208—4) Acoustic-emission crack-detection methods for light-water-reactor application.** McElroy, J.W. (Philadelphia Electric Co., PA (USA)). 7 Jun 1982. Contract AC02-79ET35208. 84p. (ADAB—2-44). NTIS, PC A04/MF A01. Order Number DE83002800.

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This paper presents the results of a portion of a research program being sponsored by the Department of Energy and Philadelphia Electric Company. The research program covers the application of the acoustic emission technology to on-line monitoring of light water reactors. The portion of that program being addressed in this paper is the application of acoustic emission techniques for crack detection. The report defines acoustic emission and presents methods for the application of the AE technique for on-line monitoring. Results obtained from investigations into the physical limits of the technique are presented, such as background operating noise effects, attenuation effects, and sensor spacing. A concept is developed for relating acoustic emission indications to source severity. On-line monitoring results are then presented from separate programs run at several operating generating stations.

7456 **(GEAP—22201) Flow-induced vibration characteristics of BWR/6-238 jet pumps.** Schardt, J.F. (General Electric Co., San Jose, CA (USA). Nuclear Engineering Div.). Sep 1982. Contract AC02-77ET34209. 104p. NTIS, PC A05/MF A01. Order Number DE83003103.

Four prototype BWR/6-238 jet pumps (two jet pump pairs) were tested to determine their flow-induced vibration (FIV) characteristics in the High Flow Hydraulic Facility, (HF)^2, over the period June to September 1978. Tests consisted of operating the jet pumps, which were heavily instrumented with accelerometers, pressure transducers and strain gages, at the design operating condition, as well as at numerous off-design drive flows and M-ratios, and at temperatures between 70°F and 180°F and at 455 psig. Results were combined with those from past jet pump tests to predict the response at reactor temperature (533°F). Major conclusions reached related to the BWR/6-238 jet pump are presented.

7457 (GRS—19(8-80), pp 133-136) **Summary of session II.** Espefaelt, R.; Berhara, D. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

7458 (GRS—19(8-80), pp 169-177) **Training of power plant operators by the use of a simulator closely reproducing another plant.** Gnosspelius, C.F.; Persson, P.E.; Carlsson, R.I. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

AKU Nuclear Power Training Center is situated in the neighbourhood of the state-owned research station Studsvik 100 kilometers south of Stockholm at the Baltic coast. There are now two full scope simulators at the Training Center, one for PWR- and one for BWR- operator training. AKU is providing training to ten existing light water reactor units in Sweden and also to the two BWR units in Finland. In the Training Center there are also facilities like class rooms, equipment for the production training materials, and trainee recreation areas.

7459 (GRS—19(8-80), pp 181-195) **BWR operators training experience using simulator.** Kawashima, S. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Since BWR Training Center received its first class of trainees for Operator Retraining Course in 1974, many trainees including suboperators, operators and supervisors were given highly abnormal and emergency situations which are not likely to occur in the actual control room. This paper describes the standard training program established to prepare the operator to the proficient in BWR power plant operation and training experience including an example of the combined troubles.

7460 **(NUREG—0744-Vol.1-Rev.1) Resolution of the Task A-11 reactor-vessel materials-toughness safety issue. Part I. Main report. Part II. Staff responses to public comments, and Appendices A and B.** Johnson, R. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1982. 180p. NTIS, PC A09/MF A01 - GPO $7.00. Order Number DE83900471.

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This report provides the NRC position with respect to the reactor pressure vessel safety analysis required according to the rules given in the Code of Federal Regulations, Title 10 (10 CFR). An analysis is required whenever neutron irradiation reduces the Charpy V-notch upper shelf energy level in the vessel steel to 50 ft-lb or less. Task A-11 was needed because the available engineering methodology for such an analysis utilized linear elastic fracture mechanics principles, which could not fully account for the plastic deformation or stable crack extension expected at upper shelf temperatures. The Task A-11 goal was to develop an elastic-plastic fracture mechanics methodology, applicable to the beltline region of a pressurized water reactor vessel, which could be used in the required safety analysis. The goal was achieved with the help of a team of recognized experts. Part I of this volume contains the For Comment NUREG-0744, originally published in September 1981 and edited to accommodate comments from the public and the NRC staff. Edited segments are noted by vertical marginal lines. Part II of this volume contains the staff's responses to, and resolution of, the public comments received.

7461 **(NUREG—0744-Vol.2-Rev.1) Resolution of the Task A-11 reactor-vessel materials-toughness safety issue. Appendices C-K.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1982. 281p. NTIS, PC A13/MF A01. Order Number DE83900470.

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The central problem in the unresolved safety issue A-11, Reactor Vessel Materials Toughness, was to provide guidance in performing analyses required by 10 CFR Part 50, Appendix G, Section V.C. for reactor pressure vessels (RPVs) which fail to meet the toughness requirement during service life as a result of neutron radiation embrittlement. Although the methods of linear-elastic fracture mechanics (LEFM) were adequate for low-temperature RPV problems, they were inapplicable under operating conditions because vessel steels, even those which exhibit less than 50 ft-lb of C/

sub v/ energy, were relatively tough at temperatures where the impact energy reached its upper shelf values. A technical team of recognized experts was organized to assist the NRC staff in addressing the problem. Using the foundation of the tearing modulus concept, which had been developed under earlier NRC sponsorship, relationships were obtained which provided approximate solutions to the problem of RPV fracture with assumed beltline region flaws. The first paper of this report is a summary of the problem, the solutions, and the results of verification analyses. The details are provided in a series of appendices in Volumes I and II.

7462 **(NUREG/CR—2378) Nuclear power plant operating experience - 1980. Annual report.** Mays, G.T.; Haried, J.A.; Kukielka, C.; Seagren, R.D. (Oak Ridge National Lab., TN (USA)). Oct 1982. Contract W-7405-ENG-26. 318p. (ORNL/NSIC—191). NTIS, PC A14/MF A01 - GPO $10.00. Order Number DE83002231.

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This report is the seventh in a series of reports issued annually that summarizes the operating experience of nuclear power plants in commercial operation in the United States. Power generation statistics, plant outages, reportable occurrences, fuel element performance, and occupational radiation exposure for each plant are presented and discussed, and summary highlights are given. The report includes 1980 data from 67 plants - 24 boiling-water-reactor plants, 42 pressurized-water-reactor plants, and 1 high-temperature gas-cooled reactor plant.

7463 **(PNL-SA—10743) Spectra and dosimetry for high and low energy photons at light water reactors.** Roberson, P.L.; Endres, G.W.R.; Fox, R.A.; Haggard, D.L.; Holbrook, K.L.; Rathbun, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1982. Contract AC06-76RL01830. 11p. (CONF-821037—32). NTIS, PC A02/MF A01. Order Number DE83003465.

From 10. water reactor safety research information conference; Gaithersburg, MD, USA (12 Oct 1982).

Portions of document are illegible.

Field measurements are being performed at commercial nuclear power plants to aid an evaluation of the impact of revisions of 10 CFR 20 on licensees and to aid an evaluation of the adequacy of regulations for monitoring dose due to high-energy photons (> 3 MeV). proposed modifications to 10 CFR 20 incorporate improved exposure-to-dose-equivalent conversion factors (C/sub x/ factors) for low-energy photons. These factors differ from the currently-specified factor of unity by as much as 50%. The improved C/sub x/ factors are shown. They were developed for the four-element, 30-cm diameter ICRU sphere by Dimbylow and Francis (1979).

7464 **On-line recording and evaluation in core measuring data in light water reactors.** Grondey, G.; Gebureck, P.; Stegemann, D. *Atomkernenergie/Kerntechnik;* **41**: No. 3, 195-199(1982). (In German).

A Multichannel On-line Noise Analysis System (MONAS) with the aim of early fault detection is described. Experiences from the application at a nuclear power plant are given. Reduction of measuring data is done by calculating stochastic functions. The characteristic values are automatically checked against preset limits. Any relevant excess of limits intializes permanent recording of the data, which were gained during the last 8 hours before the event, and starts analog recording of the noise signals. This allows a very detailed analysis of the data, especially of those before the event and achieves criteria for an early fault detection. Experiences during an on-line surveillance of 32 LPRM signals of the BWR demonstrate the broad potential of the system.

7465 **Analysis of residual stresses in girth welded type 304 stainless steel pipes.** Brust, F.W.; Kanninen, M.F. (Battelle, Columbus Lab, Ohio, USA). *Journal of Materials for Energy Systems;* 3: No. 3, 56-62(Dec 1981).

Intergranular stress corrosion cracking (IGSCC) in boiling water reactor (BWR) piping is a problem for the nuclear power industry. Tensile residual stresses induced by welding are an important factor in IGSCC of Type 304 stainless steel pipes. Backlay and heat sink welding can retard IGSCC. 17 refs.

7466 **Analysis of Peach Bottom turbine trip tests.** Cheng, H.S.; Diamond, D.J.; Hsu, C.J.; Levine, M.M.; Lu, M.S.; Odar, F.; Shier, W.G. (BNL-USA). *Transactions of the American Nuclear Society;* **31**: 102-104(1979). (CONF-790519—).

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 7455, 7457, 7458, 7460, 7461, 7462, 7463, 7464, 7507, 7509, 7534, 7535, 7542, 7545, 7546, 7552, 7556, 7558, 7559, 7564, 7584, 7587, 7588, 7589, 7594, 7597, 7600, 7605, 7610, 7612, 7614, 7621, 7622, 7623, 7624, 7628, 7629, 7631, 7638, 7639, 7641, 7642, 7643, 7644, 7645, 7646, 7647, 7648, 7649, 7650, 7651, 7652, 7654, 7655, 7658, 7659, 7661, 7663, 7732, 7917

7467 **(EPRI-NP—2691) Evaluation of abrasive grit - high-pressure water decontamination. Final report.** Sejvar, J.; Dawson, P.H. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Service Div.). Oct 1982. 62p. NTIS, PC A04/MF A01. Order Number DE83900613.

This report is associated with a comprehensive review of various chemical and mechanical decontamination methods being conducted by the Electric Power Research Institute. The primary goal of this review is to identify potential state-of-the-art methods for use in decontamination of fluid systems at the Three Mile Island Unit 2 (TMI-2) facility. The particular method addressed in this study is an abrasive grit/high-pressure water technique developed primarily for decontamination of steam generator channel heads. Included in the report is a description of the system and summaries of field experience to date. Also included are general guidelines, criteria, and pertinent parameters which must be considered in the application of this decontamination method as well as a general assessment of the applicability of this process to various components and systems.

7468 **(EPRI-NP—2692-Vol.1) In-air vibration analysis of Three Mile Island Unit-2 once-through steam generator tubes. Volume 1.** Simonis, J.C. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Oct 1982. 87p. NTIS, PC A05/MF A01. Order Number DE83900564.

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Resonant frequencies were determined for 100 randomly selected tubes and tubes selected for instrumentation during power operation. The average fundamental resonant frequency of the tubes tested was approximately 65 Hz. No spatial distribution of resonant frequency associated with the OTSG was discerned. Mode shapes were determined for five tube spans bounded by the fifteenth support plate and upper tubesheet and one tube span between the ninth and tenth support plates. The boundary conditions associated with the mode shapes varied from simple support to clamped at both ends. The in-air test results are useful for interpreting test data acquired from the permanently installed instrumentation during power operation at Three Mile Island Unit 2.

7469 **(EPRI-NP—2698-CCM-Vol.2) ATHOS: a computer program for thermal-hydraulic analysis of steam generators. Volume 2. Programmer's manual.** Singhal, A.K.; Keeton, L.W.; Przekwas, A.J.; Weems, J.S. (CHAM of North America, Inc., Huntsville, AL (USA)). Oct 1982. 150p. NTIS, PC A07/MF A01. Order Number DE83900535.

ATHOS (Analysis of the Thermal Hydraulics of Steam Generators) is a computer code developed by CHAM of North America Incorporated, under the contract RP 1066-1 from the Electric Power Research Institute, Palo Alto, California. ATHOS supercedes the earlier code URSULA2. ATHOS is designed for three-dimensional, steady-state and transient analyses of PWR steam generators. The current version of the code has been checked out for: three different configurations of the recirculating-type U-tube steam generators; the homogeneous and algebraic-slip flow models; and full and part load operating conditions. The description of ATHOS

is divided into the following four volumes: Volume 1, Mathematical and Physical Models and Methods of Solution; Volume 2, Programmer's Manual; Volume 3, User's Manual; and Volume 4, Applications. The code's possible uses, capabilities and limitations are described in Volume 1 as well as in Volume 3.

7470 **(EPRI-NP—2703) Salem Unit 1 - denting mitigation program: implementation of improved oxygen, chloride, and copper control. Final report.** Battaglia, P.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Div.). Oct 1982. 139p. NTIS, PC A07/MF A01. Order Number DE83900525.

The purpose of this program, performed during cycle 3 operation, was to document Salem Unit 1, cycle 3 chemistry and determine by hydrogen monitoring and eddy current inspection if the secondary chemistry parameters as controlled were effective in eliminating any continuation of denting to the Salem Unit 1 steam generators. Results indicated that the program was effective in eliminating denting.

7471 **(EPRI-NP—2704-SR) PWR secondary water chemistry guidelines.** Bell, M.J.; Blomgren, J.C.; Fackelmann, J.M. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.). Oct 1982. 94p. NTIS, PC A05/MF A01. Order Number DE83900573.

Steam generators in pressurized water reactor (PWR) nuclear power plants have experienced tubing degradation by a variety of corrosion-related mechanisms which depend directly on secondary water chemistry. As a result of this experience, the Steam Generator Owners Group and EPRI have sponsored a major program to provide solutions to PWR steam generator problems. This report, PWR Secondary Water Chemistry Guidelines, in addition to presenting justification for water chemistry control parameters, discusses available analytical methods, data management and surveillance, and the management philosophy required to successfully implement the guidelines.

7472 **(EPRI-NP—2715) R curve characterization of low-strength structural steels. Final report.** Menke, B.H.; Hiser, A.L.; Hawthorne, J.R.; Loss, F.J. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Oct 1982. 86p. NTIS, PC A05/MF A01. Order Number DE83900579.

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The fracture toughness of three, low strength, structural steels is determined in this study. The relationships between fracture toughness, Charpy energy, drop weight and dynamic tear test results are investigated. The full fracture toughness transition curve is generated for each material. Wherever possible, the J resistance curves are developed.

7473 **(KFK—3206) Physico-chemical radioiodine species in the exhaust air of a pressurized water reactor (PWR2).** Deuber, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Dec 1981. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750416.

In a German pressurized water reactor, the physico-chemical ^{131}I species were determined in the plant exhaust and in the individual exhausts during 6 months. These measurements aimed in particular at determining the percentage and the source of the radiologically decisive elemental ^{131}I released to the environment. The retention of the ^{131}I species by iodine filters was also investigated. 20 to 30% of the ^{131}I discharged with the plant exhaust consisted of elemental iodine. This was largely released with the unfiltered exhaust from the chemical laboratory hoods and from the annular compartment.

7474 **(KFK—3279) Critical heat flux correlation for advanced pressurized light water reactor application.** Dalle Donne, M.; Hame, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). May 1982. 90p. (EUR—7057e). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750981.

Many CHF-correlations have been developed for water cooled rod clusters representing typical PWR or BWR fuel element geometries with relative wide rod lattices. However the fuel elements of an Advanced Pressurized Water Reactor (APWR) have a tight fuel rod lattice, in view of increasing the fuel utilization. It was therefore decided to produce a new CHF-correlation valid for rod bundles with tight lattices. The already available WSC-2 correlation was chosen as a basis. The geometry dependent parameters of this correlation were determined again with the method of the root mean square fitting from the experimental data of the CHF-tests performed in the frame of the Light Water Breeder Reactor programme at the Bettis Laboratory. These tests include triangular array rod bundles with very tight lattices. Furthermore the effect of spiral spacer ribs was investigated on the basis of experimental data from the Columbia University. Application of the new CHF-correlation to conditions typical for an APWR shows that the predicted critical heat fluxes are much smaller than those calculated with the usual PWR-CHF-correlations, but they are higher than those predicted by the B+W-VPI+SU correlation.

7475 **(PB—82-204389) Hydrogen-assisted crack growth of A508-2 in high-temperature pressurized reactor-grade water.** Toeroenen, K.; Provenzano, V.; Gabetta, G.; Cullen, W.H. Jr; Watson, H.E. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). Mar 1980. 38p. NTIS, PC A03/MF A01.

Based on fractographic evidence the accelerated fatigue crack growth rate seen under certain circumstances at simulated pressurized water reactor grade water in A508-2 forging steel is due to hydrogen assistance. Hydrogen entry into the crack tip region and subsequent high crack growth rate occurs at lower temperatures when the time of the fatigue cycle exceeds a certain limit of the order of seconds. At higher temperatures, close to the reactor operating temperatures, hydrogen entry is possible only at certain intermediate frequencies; the rapid repassivation or crack tip blunting at lower frequencies prevents this effect. At low Delta K-levels hydrogen entry may be too limited to introduce any effect, at higher Delta K-levels the accelerated crack growth rates bendover back to the ASME air line occurs, this being due to a change in crack growth mechanism or electrochemical conditions at the crack tip.

7476 **Optimization of the refuelling schedule of a PWR electric power generation system: the planum model.** Merlin, A.; Roussel, P. (Electricite de France, Clamart). pp 337-344 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

New specific problems arise from the incorporation of a large number of Pressurized Water Reactors in the electric power generation system of Electricite de France, with regard to the determination of their refuelling schedule. Because of random factors affecting operation of reactors, refuelling and maintenance shutdowns would be randomly distributed along the year, if the reference energy had to be delivered during each cycle without any possibility to anticipate or delay the end of the cycle. Thus, the aim is to minimize the operational cost of the system, with respect to the refuelling dates. A modelization of this problem, and the consequent two-stage optimization algorithm, are proposed. The operational cost and the energy production schedule of each unit are determined through the resolution of a linear program; the optimal schedule results from a search method based on the existence of a sub-gradient.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 7462, 7519, 7538, 7570, 7615, 7616, 7665, 7666

7477 (DOE/ET/34202—71) Advanced-Gas-Cooled Nuclear-Reactor Materials Evaluation and Development Program. Progress report, January 1-March 31, 1982. (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). 30 Jul 1982. Contract AC02-76ET34202. 85p. NTIS, PC A05/MF A01. Order Number DE83003353.

This report presents the results of work performed from January 1, 1982 through March 31, 1982 on the Advanced Gas-Cooled Nuclear Reactor Materials Evaluation and Development Program. Work covered in this report includes the activities associated with the status of the simulated reactor helium supply systems and testing equipment. The progress in the screening test program is described; this includes screening creep results and metallographic analyses for materials thermally exposed or tested at 750°, 850°, 950° and 1050°C (1382°, 1562°, 1742° and 1922°F) in controlled-purity helium. The status of creep-rupture in controlled-purity helium and air and fatigue testing in controlled-purity helium and air in the intensive screening test program is discussed. The results of metallographic studies of multispecimen creep specimens tested at 950°C for 6000 hours (solid solution strengthened alloys and an iron-base oxide dispersion strengthened alloy) are presented and discussed.

7478 (GRS—19(8-80), pp 199-203) **Operator training facilities for CEGB advanced gas cooled reactors.** Green, J.F.; Birnie, S. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The facilities provided at the Nuclear Power Training Centre of the CEGB for the training of operators fo the AGR are described. The simulator control desks are replicas of three AGR designs with, in addition, simulation of the Data Processing System for each station. Three modes of operation are envisaged: a.) Demonstration where the simulator is used by the tutor to illustrate lecture on plant behaviour. b.) Interaction where the student carries out normal procedures and experiences plant failure situations. c.) Investigation where engineering staff use the simulator for validation of modified operational procedures, ergonomic studies etc.

7479 (Juel—1760) Investigation of core neutronics calculational methods for the HTR-critical experiment (KAHTER) with regard to the validity of calculation of the influence of the upper cavity. Pohlen, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Jan 1982. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750955.

This report deals with the checking of computations of various experiments at the critical facility for the high temperature pebble bed reactor (KAHTER). In particular computational methods are tested which are to be used for treating the cavity and for calculating the efficiency of absorber rods in pebble bed reactors with OTTO-loading. In addition, with regard to a top reflector-instrumentation, the effects of disturbances in the upper core region on the shape of neutron flux in the top reflector are studied. In the diffusion calcualtions for determination of critical masses and neutron flux distributions of various core configurations, standard diffusion programs are used such as the 2D-code DIFF-2D and the 2- and 3-dimensional program CITATION, as well as recently developped diffusion codes. To the latter belong the program HRMC/DIFF-H, which treats the cavity by means of transport theory, and the finite element code DIFGEN. For comparison, Monte Carlo calculations are performed with the MORSE-K code.

7480 (Juel—1768) Computational analysis of cesium-diffusion in irradiation experiments under consideration of concentration- and release-measurements. Biedermann, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Feb 1982. 178p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750990.

Thesis. Submitted to Technische Hochschule Aachen, Germany, F.R.

An important step on the way of forecasting a high-temperature reactor's fission-product release is to recalculate fission product profiles and releases, measured on coated fuel particles after having been irradiated in inpile-experiments. The diffusion coefficient which characterizes the hability of fission product retention is derived out-of-pile from laboratory annealing tests with irradiated fuel particles. Comparing calculated profiles and releases with measured ones, its application in the recalculation of irradiation experiments will answer the question of transmitting 'laboratory coefficients' onto reactor conditions. This work enlights the sequence of irradiation experiment's recalculation. Diffusion coefficients will be presented for the isotope Cs-137 in different material shells of the coated fuel particle.

7481 (Juel—1777) Investigation of the Xenon-induced azimuthal power oscillations with the pebble bed high-temperature reactor of the HTR-V-project. Mertens, J.; Lauer, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Mar 1982. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750986.

The stability against azimuthal Xenon-induced power oscillations is investigated for the equilibrium cycle of the 2250 MW(th) core of the HTR-V-project. To this subject three studies are presented. 1. The three-dimensional steady-state core with its neutronic and thermo-hydratulic space functions is very precisely computed using a detailed reactor model. Results are illustrated by means of various computer plots. 2. The temperature coefficients of the reactivity are determined for the full-load operation condition; they result to be strongly negative due to the LEU fuel loading. 3. The typical shape and the time-behaviour of Xenon oscillations in the most unstable first azimuthal mode are analyzed with the aid of explicite two-dimensional transient calculations with and without temperature feedback. The inherent damping constant of the possible free oscillations is calculated to 0.14 h^{-1} and their period to 35 h.

7482 (Juel-Spez—151) Theoretical studies for the initial core of a 300 MWe pebble bed reactor during loading. Zhao, Y.; Neef, R.D.; Schaal, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). May 1982. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82751057.

Theoretical analysis on a loading experiment of a pebble bed reactor particularly in regard to the loading method, has been performed. This report describes the calculating models and gives information for the first loading. An alternative loading scheme has been examined, in which at the beginning of the loading experiment the lower part of the core is filled with graphite spheres only. It is shown that nitrogen as a neutron poison for compensating excess reactivity may be used.

7483 (ORNL/TM—8284) Sorption/desorption behavior of iodine on graphite. Lorenz, R.A.; Dyer, F.F.; Towns, R.L. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 78p. NTIS, PC A05/MF A01. Order Number DE83003172.

An experimental program was undertaken to extend the data on the sorption and desorption of iodine on graphite to more realistic high-temperature gas-cooled reactor (HTGR) operating conditions. This was accomplished by heating compacts of H-451 or S-2020 graphite at 250 to 1000°C in continuously flowing helium (at atmospheric pressure) that contained iodine at pressures of 10^{-6} Pa (10^{-11} to 10^{-1} to 10^{-6} bar). Equilibrium adsorption data were generally well-behaved and reproducible with the H-451 graphite. Type S-2020 graphite sorbed more iodine, especially in the temperature range 700 to 800°C. Although desorption appeared to initiate as re-

versible sorption, the rate of loss of iodine decreased with time. During desorption from the S-2020 graphite at 700 and 800°C, a temporary plateau was reached that was sensitive to helium flow and pressure.

7484 **Materials for HTR facilities.** Nickel, H. *ATW, Atomwirtschaft, Atomtechnik;* **27**: No. 7, 380-381(Jul 1982). (In German).

The announcement of further delays in the completion of the thorium high temperature reactor (THTR) has not only started a debate about the way in which to finance the extra cost incurred for this prototype reactor, but also cast doubt in general on the high temperature reactor line. One argument frequently used against this line is the statement that no materials are available for the high temperature section of the plant. In this general form, that statement is now wrong. It is correct that the industries and research establishments involved in the development of advanced HTR plants, recognizing the inadequacy of our knowledge about the necessary materials at that time, initiated a broad, expensive materials reinforcement and testing program, which is still going on. In the light of the results of this program it is safe to say that the materials needed for components of advanced high temperature reactor plants will be available in time.

7485 **Terminology of carbon.** *Berichte der Deutschen Keramischen Gesellschaft;* **59**: No. 4, 256-257(4 Jun 1982). (In German).

Summary of the meeting of the working group 'carbon' of April 21/22, 1982 at Buchtal. The following lectures are reported: S. Wilkening: Possibilities of vibrational forming in the sector of carbon engineering; H. Luhleich, F.J. Dias and M. Kampel: The coat-mix process and its applications; A. Schmidt and E. Hornischer: Interpretation of a side reflector of a HTR-type reactor; D. Kubaschewski and B. Heinrich: Graphite-corrosion due to water vapor.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 7533, 7536, 7537

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 7474, 7507, 7554, 7555, 7557, 7568, 7572, 7573, 7580, 7586, 7630, 7632, 7633, 7634, 7640, 7668

7486 **(GAO/EMD—82-79) Liquid metal fast breeder reactor: options for deciding future pace and direction.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 12 Jul 1982. 54p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760.

Report by the Comptroller General of the United States. Portions of document are illegible.

This report (1) summarizes GAO's work in recent years on both the LMFBR program and the Clinch River project, (2) provides a current perspective on nuclear power from which to guide the current breeder program, and (3) presents information on options available to congressional decision-makers for their use in deciding on the program's future pace and direction.

7487 (GRS—19(8-80), pp 139-150) **Design of the PEC reactor training simulator.** Vaccarino, G. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

A summarized description of the PEC simulator, designed for operators' training and operational support, is given. The design choices as a result of the training and operational support requirements are discussed.

7488 (GRS—19(8-80), pp 153-165) **Evaluation of liquid metal fast breeder reactor operator training simulator.** Kameda, A.; Sato, M.; Sato, T.; Sakuragi, M. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The following items have been studied: 1) Evaluation of the general specification for the training simulator. 2) Evaluation of the simulation models. 3) Verification of the simulation models (dynamic models). 4) Evaluation of the equipments for the training simulator. 5) Investigation of the preceeded simulators. 6) Evaluation of the development schedule for this training simulator.

7489 **(KFK—3176) Theory of elasticity of nuclear fuel element mechanics, caused by rapid change of the reactor-power.** Keller, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Mar 1982. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750681.

In this report simple formulas are developed from Hooke's law by an extensive expense of mathematics. They allow to calculate, in a convenient manner, the stresses in a nuclear reactor fuel pin, caused by a rapid change of the reactor power.

7490 **(LA—9517-PR) Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, April 1-June 30, 1982.** Maraman, W.J. (comp.). (Los Alamos National Lab., NM (USA)). Sep 1982. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01. Order Number DE83002915.

This is the thirty-first quarterly report of the Examination of Fast Reactor Fuels and Fast Breeder Reactor (FBR) Analytical Quality-Assurance Standards and Methods at the Los Alamos National Laboratory. Most of the investigations discussed here are of the continuing type. Results and conclusions described may therefore be changed or augmented as the work progresses.

7491 **(RRC—44) System for evaluation of physical progress of FBTR project.** Subramanian, S.; Ramanadhan, M.M.; Venkateswarlu, A. (Reactor Research Centre, Kalpakkam (India)). 1981. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE83900586.

Portions of document are illegible.

The basic need for evaluation of the performance of a Project is a system of progress measurement, which determines the work content and progress of every physically identifiable and controllable unit of work (Work Breakdown Structure-WBS) that constitutes the Project. In order to have uniformity and consistency in assessing the work content and physical progress, it is essential to have a common base for work content and progress measurement. This report summarizes the mode of choosing the common base and the methodology evolved, for FBTR Project, to arrive at the weightages for each 4 digit USI in terms of various disciplines viz., Engineering, Procurement and Construction. Further, the methodology adopted to compute the percentage completion of the project at any instant, based on the actual progress of the three disciplines of each 4 digit USI, is outlined.

7492 **(RRC—48) Monte Carlo simulation of the benchmark experiment on neutron transport in thick sodium.** Murthy, I.; Murthy, K.P.N. (Reactor Research Centre, Kalpakkam (India)). 1981. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83900583.

Portions of document are illegible.

Monte Carlo simulation of the benchmark experiment on neutron transport through thick sodium has been taken up to validate some of the modified variance reduction devices and random sampling techniques developed here. The transmitted neutron spectrum measured in terms of the bonnerball count rates are compared with the results of our simulation, for the two cases of 2.5 feet and ten feet thick sodium. The count rates obtained elsewhere, using the codes MORSE and DOT, are also presented for comparison. Our simulation compares well with the measurements and other calculations.

7493 **(WAPD-TM—1536) Irradiation growth of Zircaloy (LWBR Development Program).** Willard, H.J. Jr. (Bettis Atomic Power Lab., Pittsburgh, PA (USA)). Nov 1982. Contract AC11-76PN00014. 42p. NTIS, PC A03/MF A01. Order Number DE83003042.

A model of irradiation growth of Zircaloy is presented based on two new mechanisms: (1) the direct production of interstitial dislocation loops accompanied by Seeger zones in the primary damage event, and (2) accelerated, nonrecoverable strain due to the activation of Frank-Read sources by internal stresses produced by the growth of dislocation loops. It is demonstrated that this approach can represent the general shape of the growth curve for longitudinally oriented RXA (recrystallized annealed) material, the effect of cold-work on growth, and a positive temperature dependence. The model has been used to demonstrate that nonlinear flux dependence can exist in growth behavior under various conditions of temperature and material structure and that this dependence can change as the irradiation history accumulates. Furthermore, it is shown that the temperature dependence of growth strain varies with time under irradiation.

7494 **Device for holding and supplying with liquid metal an assembly for a nuclear reactor core.** Arnaud, G.; Chiarelli, G. (to Commissariat A L Energie Atomique (France)). US Patent 4,352,778. 5 Oct 1982. Priority date 14 Dec 1978, France, vp.

PAT-APPL-101075.

The fuel assembly is supported by means of a cylindrical supporting member which is introduced into a shore of the cross-member. The foot of the fuel assembly is introduced into the upper part of the cross-member. Orifices, coinciding with those made with the shore permit the introduction of the liquid metal into the supporting member and from there into the actual assembly. The supporting member is closed at its lower end. Application to the construction of the core of a fast neutron nuclear cooled with liquid sodium.

7495 **Crack propagation in irradiated B/sub 4/C induced by swelling and thermal gradients.** Hollenberg, G.W.; Basmajian, J.A. (Hanford Eng Dev Lab, Richland, WA, USA). *Journal of the American Ceramic Society;* **65**: No. 4, 179-181(Apr 1982).

Boron carbide is used in fast breeder reactors as the neutron absorber material. The irradiated pellets were observed to crack. Radial thermal gradients are produced as a result of internal heat generation. In larger-diameter pellets, these thermal expansion gradients are large and it was observed that pellet cracking occurred early in operation. It was also observed that swelling gradients were established at high burnup levels. These pellets were also cracked but in a different manner. 5 refs.

7496 **Measurement of the average number of prompt neutrons from spontaneous fission of californium-252.** Spencer, R.R.; Gwin, R.; Ingle, R. (Oak Ridge Natl Lab, TN, USA). *Nuclear Science and Engineering;* **80**: No. 4, 603-629(Apr 1982).

The Oak Ridge National Laboratory large liquid-scintillator detector was used in a precise determination of the number of neutrons emitted promptly, from spontaneous fission of /sup 252/Cf. Measurements of the detector efficiency over a broad energy region were made by means of a proton-recoil technique employing the Oak Ridge Electron Linear Accelerator "white" neutron source. Refs.

7497 **Mechanical properties of a 2-1/4 Cr-1 Mo steel tubesheet forging.** Klueh, R.L.; Griffith, J.L. (Oak Ridge Natl Lab, TN, USA). *Journal of Materials for Energy Systems;* **3**: No. 3, 26-38(Dec 1981).

Tensile and creep-rupture properties were determined on specimens taken from the cylindrical forging in the as-received condition and on pieces given a laboratory isothermal anneal. Near the external cylindrical surface, the microstructure was similar to that of the laboratory isothermally annealed steel and contained about 10 pct bainite. For specimens taken at intervals toward the center of the forging, the amount of bainite increased and went through a maximum of about 30 pct, then decreased to about 25 pct at the center. Strength also went through a maximum with distance into the forging. This nonuniformity was attributed to a nonuniformity of cooling rate. Strength changes were attributed to carbide precipitation reactions at elevated temperatures. 16 refs.

7498 **Comparison of the COMMIX-2 two phase flow model with experimental data.** Bartzis, J.G.; Krazinski, J.L.; Shah, V.L. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 669-671(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7499 **A simple approach to thermal-hydraulic analysis of distorted rod bundles.** Chen, B.C.J.; Sha, W.T. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 671-673(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7500 **Numerical thermal-hydraulic simulation of an LMFBR pipe during a flow coastdown.** Chen, M.J.; Domanus, H.M.; Sha, W.T. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 673-675(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7501 **Development and performance of metal fuel elements for fast breeder reactors.** Kittel, J.H.; Walters, L.C. (ANL-USA, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **31**: 177-179(1979). (CONF-790519—).

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

7502 **(RISLEY-Trans—4069) Main BOR-60 reactor operating results 1970-1977.** Gryazev, V.M.; Smirnov, A.M. (UKAEA Risley Nuclear Power Development Establishment). [nd]. Translation source information not available . 8p. Dep. NTIS (US Sales Only), MF A01. Order Number DE82906186.

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The prolonged and generally successful operation of the principal systems and various items of equipment in the sodium circuits of the BOR-60 reactor have confirmed the validity of the technical solutions adopted and have enabled considerable practical experience to be accumulated under normal conditions of operation and in the elimination of the consequences of any failures which have occurred.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 7540, 7585, 7608

7503 **(GRS—43) Nuclear licensing and supervisory procedures for nuclear facilities in the Federal Republic of Germany.** Franzen, L.F. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Feb 1982. 85p. NTIS (US Sales Only), PC A-5/MF A01. Order Number DE82751051.

A combined system has been developed in the Federal Republic of Germany: the States execute the Atomic Energy Act on behalf of the Federal Government. Despite these differences, the safety requirements and the safety standard achieved vary only insignificantly, as a result of a world-wide communication and of international cooperation. The legal prerequesites for the German nuclear licensing procedures have been established about 20 years ago, and, by a number of amendments have been adapted to new perceptions and developments. Several supplementary ordinances, due to further developments in nuclear technology, are being prepared. The work on associated technical provision, which had been neglected for a long time, has in recent years been tackled systematically and should, before long, lead to a comprehensive programme of safety standards, which simplifies and expedites the nu-

clear licensing procedures. Essential features of the licensing procedure are the phased structure and the division into intermediate steps which render it possible to adapt the safety requirements to the advancing state of science and technology. The responsible authorities call in experts for the safety verification of the application documents. It is the task of these experts to make assessments and to conduct quality examinations in the manufacturing plants and at the site, and to carry out recurrent tests. The public is involved by the announcement of the projects, the display of the documents and by the opportunity to raise objections during the licensing procedure. Licenses granted can be contested before the administrative courts. This procedure paves the way for the achievement of a satisfactory balance between private and public interests.

7504 **(GRS-S—36) Atomic law licensing procedure for nuclear facilities.** Franzen, L.F. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jul 1981. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750417.

In all countries with a nuclear energy programme the atomic law licensing and supervising procedures hardly differ in their targets, however, when they are being realized a centralistic procedure shall be preferred even in federally administered countries in most cases. In contrast to this a mixed system has developed in the F.R. of Germany: the Laender are the executives of Atomic Law on behalf of the Bund. The essential characteristics of the licensing procedure are the multistage method and the division into intermediary stages which facilitate the adaption of the safety requirements to the respective state of science and technology. The responsible authorities consult experts for checking the safety engineering requirements of the application papers. These experts are also in charge of writing reports as well as of controlling both the production and the building site. They are also responsible for periodical tests. The public participates in the licensing procedure by being informed of the project, having access to the application papers, and by being able to enter protests. Licensing notices are voidable provided that they are submitted to an administrative court.

7505 **(NUREG—0304-Vol.7-No.3) Regulatory and technical reports: compilation for third quarter 1982 July-September.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Nov 1982. 145p. NTIS, PC A07/MF A01 - GPO. Order Number DE83900669.

This compilation consists of bibliographic data and abstracts for the formal regulatory and technical reports issued by the US Nuclear Regulatory Commission (NRC) Staff and its contractors. It is NRC's intention to publish this compilation quarterly and to cumulate it annually. The main citations and abstracts in this compilation are listed in NUREG number order: NUREG-XXXX, NUREG/CP-XXXX, and NUREG/CR-XXXX. This precede the following indexes: Contractor Report Number Index; Personal Author Index; Subject Index; NRC Originating Organization Index (Staff Reports); NRC Contract Sponsor Index (Contractor Reports); Contractor Index; and Licensed Facility Index.

7506 **(NUREG—0435-V4-N1) Research project control system (RPCS): status summary report, data covering three quarters from July 1981-March 1982, research results utilization.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1982. 228p. NTIS, PC A11/MF A01.

This report provides status and control information concerning the utilization of research results in the regulatory policies and practices of the NRC. Section 3.0 of this report lists the RILs issued to date, together with an identification of the research program manager and the research program element which generated the RIL. The potential applicability of each RIL to the regulatory process is also identified.

7507 **(NUREG—0580-Vol.11-No.10) Regulatory licensing status summary report. Nuclear power plants data for decisions (blue book), September 15-October 15, 1982.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Oct 1982. 68p. NTIS, PC A04/MF A01 - GPO. Order Number DE83900478.

This management report, Regulatory Licensing Status Summary Report, is designed to provide the necessary information for controlling the progress of review processes for central station nuclear reactor applications. It utilizes data collected from the Office of Nuclear Reactor Regulation, Office of the Executive Legal Director, Office of Inspection and Enforcement, and the national laboratories, and analyzed by the Office of Resource Management in the implementation of the regulatory information system. Section I of this edition consists of the three summary of accomplishments, the new application forecast for OL's and CP's, and an abbreviation key. Section II represents the main body of the report and consists of the facility information. All OL's are listed first, followed by CP's, standard design reviews, other reviews, and finally, a non-power reactor summary. Each project consists of general facility data, current status for all phases of the review, and targeted and actual completion dates for all key milestones in the review.

7508 **(NUREG—0750-Vol.15-Index-1) Indexes to Nuclear Regulatory Commission issuances, January-March 1982.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1982. 66p. NTIS, PC A04/MF A01 - GPO. Order Number DE83900472.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. This information is displayed in one or more of five separate formats arranged as follows: case name index; digests and headers; legal citations index; subject index; and facility index.

7509 **(NUREG—0843-Suppl.2) Safety evaluation report related to the operation of St. Lucie Plant, Unit No. 2, Docket No. 50-389, Florida Power and Light Company, Orlando Utilities Commission of the City of Orlando, Florida.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1982. 96p. NTIS, PC A05/MF A01 - GPO $5.50. Order Number DE83900208.

On October 9, 1981, the Nuclear Regulatory Commission (NRC) staff issued a safety evaluation report (SER) related to the operation of St. Lucie Plant Unit 2. Supplement No. 1 (SSER 1) to the SER was issued in December, 1981. In the SER and SSER 1 the staff identified certain issues where either further information or additional staff effort was necessary to complete the review. The purpose of this supplement is to update the SER by providing (1) evaluation of additional information submitted by the applicant since SSER 1 to the SER was issued and (2) evaluation of the matters the staff had under review when the SSER 1 was issued.

7510 **Legal protection by the executive. Constitutional problems posed by the authorities' scope of discretion in granting licences for nuclear installations.** Fiedler, W. pp 135-148 of Rechtsstaat - Kulturerbe - Volksgruppe. Muenchen, F.R. Germany; Verlagshaus Sudetenland (1980). (In German)

The specific dangers involved in large-scale installations encounter a system of legal protection which, in its basic structures, is hardly up to the new situation. The author explains that neither the conventional theory of administrative discretion nor the well-known confrontation between executive and judicial power can cope with the new problems. Within the framework of the constitution one has to look for other opportunities to solve the problems lawfully. The author advocates the attempt to obtain legal protection by further developing the administrative proceedings and by limiting court protection basically to the control of compliance with the proceedings.

7511 **Risks and risk assessment according to British legislation.** Vieweg, K. pp 103-116 of Gefahren und Gefahrenbeurteilungen im Recht. T. 1. Vortraege und Diskussionsberichte des Kolloquiums. Lukes, R. (ed.). Koeln, F.R. Germany; Heymanns (1980). (In German)

From Colloquium on legal and technical aspects of risk and reliability analyses and their application under established law; Baden-Baden (Germany, F.R.) (11 - 14 Jul 1979).

The most important rules of the large number of legal regulations and other norms relating to risk control of technical installations discussed as far as their approach is quantitative: the regulations of the Health and Safety at Work Act of 1974, of the Factories Act of 1961, the Hazardous Installations (Notification and Survey) Regulation, the Canvey-Island Study, regulations referring to Atomic Energy Law and the administrative practice, legal regulations in the field of navigation, regulations concerning planning legislation including the Windscale-Study. In Great Britain, the power of decision in the field of technical safety has been clearly assigned to the administrative authorities. The legislature refrained from going into details in the stipulation of legal regulations, judicial control has not been provided for, or has only little relevance in practice. The prevailing goal is to reach decisions by consensus, taking every effort to solve conflicts of interest by mutual agreements. Methods and criteria in risk assessment have been modified according to technological knowledge and developments.

2108 Economics

REFER ALSO TO CITATION(S) 7714

7512 **(Juel-Conf—41) Supply, operation and radioactive waste disposal of nuclear power plants.** Mohrhauer, H.; Krey, M.; Haag, G.; Wolters, J.; Merz, E.; Sauermann, P.F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jul 1981. 57p. (In German). (CONF-810287—1). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750694.

From Seminar on supply, operation and radioactive waste disposal of nuclear power plants; Juelich, F.R. Germany (10 Feb 1981).

The subject of 'Nuclear Fuel Cycle' is treated in 5 reports: 1. Uranium supply; 2. Fabrication and characteristics of fuel elements; 3. Design, operation and safety of nuclear power plants after Harrisburg; 4. Radioactive waste disposal of nuclear power plants - changed political scenery after 1979; 5. Shutdown and dismantling of LWR-KKW - state of knowledge and feasibility.

7513 **(KFK—3248) Nuclear fuel cycle requirements in WOCA.** Klumpp, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Feb 1982. 415p. NTIS (US Sales Only), PC A22/MF A01. Order Number DE82750695.

OECD/NEA will publish an updated version of its study 'Nuclear Fuel Cycle Requirements and Supply Considerations, Through the Long-Term.' The Nuclear Research Centre Karlsruhe (KfK) was involved in the work necessary to provide this book. Although KfK had only responsiblility for part of the required computations it performed all the calculations for its own documentation interests. This documentation was felt to be a helpful background material for the reader of the second 'Yellow Book'. In this sense the original strategy computer outprints are published now without any discussion of assumptions and results.

22 NUCLEAR REACTOR TECHNOLOGY

7514 **(DOE/TIC—8200-R46) Nuclear reactors built, being built, or planned in the United States as of June 30, 1982.** Goulden, A.M. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Nov 1982. 50p. NTIS, PC A03/MF A01. Order Number DE82019247.

This semiannual compilation provides current information about facilities for domestic use or export which are capable of sustaining a nuclear chain reaction. Civilian, production, and military reactors are listed, as are reactors for export and critical assembly facilities. Information given includes location, owner, principal nuclear contractor, type, power rating, docket number, and start-up and shutdown dates.

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 7492

7515 **(RRC—51) Computer code for the Monte Carlo simulation of Knudsen effusion.** Saikumar, R. (Reactor Research Centre, Kalpakkam (India)). 1981. 23p. T. Order Number DE83900585.

Mf only; illegibility does not permit PC reproduction.

A computer program for the Monte Carlo treatment of the process of Knudsen effusion has been developed. This report gives an approach for such a treatment with details of modelling, calculations involved and the scope for further work. The salient features of the code given are: (1) lower dimensional modelling, (2) economy of computer time, (3) scope for extension to other cell models, and (4) provision for detailed parametric studies.

7516 **Review of neutron transport approximations.** Sanchez, R.; McCormick, N.J. (Univ of Washington, Seattle, USA). *Nuclear Science and Engineering;* **80**: No. 4, 481-535(Apr 1982).

Numerical methods for solving the integrodifferential, integral, and surface-integral forms of the neutron transport equation are reviewed. The solution methods are shown to evolve from only a few basic numerical approximations, such as expansion techniques or the use of quadrature formulas. The emphasis is on the derivation of the approximate equations from the transport equation, and not on the solution of the resulting system of algebraic equations. The presentation covers the approaches used in general-purpose production calculations, including the discrete ordinates finite difference method, the method of characteristics, finite element approximations, the collision-probability method, and nodal methods. Various quasi-analytical techniques for calculating benchmark problems are also treated, such as the singular eigenfunction, spherical harmonics, integral transform, and C/sub N/ and F/sub N/ methods. Refs.

7517 **Accurate evaluation of multigroup transfer cross sections and their Legendre coefficients.** Hong, K.J.; Shultis, J.K. (Kansas State Univ, Manhattan, USA). *Nuclear Science and Engineering;* **80**: No. 4, 570-578(Apr 1982).

For transport problems with fine energy group structure, the group-to-group transfer cross sections are usually quite anisotropic in the scattering angle. It is shown for neutron inelastic scattering that explicit use of the characteristic shape of these transfer cross sections permits more efficient and accurate numerical evaluation of their Legendre expansion coefficients than is afforded by existing techniques. In addition, transfer cross sections can often be well approximated by piecewise, low-order polynomials with which very accurate and simple expressions can be derived for the Legendre coefficients. This analytical approach both minimizes the access of nuclear data files and accurately determines even the higher order coefficients. Refs.

7518 **Multigroup transfer matrices for charged-particle and neutron-induced reactions - 2. an analytic integration of the inner integral.** Perkins, S.T.; Giles, P.C. (Lawrence Livermore Natl Lab, CA, USA). *Nuclear Science and Engineering;* **80**: No. 4, 579-585(Apr 1982).

The inner integral over final particle energy or collision cosine of the multigroup transfer matrix is evaluated analytically for the general nonrelativistic two-body interaction. Under the condition that the center-of-mass angular distribution is piecewise linear, the solution is exact. Refs.

7519 **Analyses of the dynamics of pebble bed high temperature reactors.** Engelbrecht, H. Juelich, Germany; Kernforschungsanlage (1981). 127p. (In German). (Juel-Spez—123).

Thesis.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 7516, 7664, 7904, 7918

7520 **(INIS-mf—7217) Materials problems of light water reactor. Conference proceedings.** (Ceska Vedeckotechnicka Spolecnost, Prague (Czechoslovakia). Dum Techniky). 1980. 164p. (In Czech). (CONF-8006242—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83780049.

From Conference on materials problems of light water reactors; Vsetin, Czechoslovakia (10 Jun 1980).

A separate abstract was prepared for each topic presented. (HDR)

7521 **Reactor unit and a nuclear installation which uses said reactor unit.** Pierart, R. (to Ateliers Et Chantiers De Bretagne (France)). US Patent 4,355,001. 19 Oct 1982. Priority date 20 Oct 1978, France, vp.

PAT-APPL-224223.

Pct no. Pct/fr79/00095 sec. 371 date jun. 20, 1980 sec. 102(E) date jun. 20, 1980 pct filed oct. 18, 1979 pct pub. No. Wo80/00893 pct pub. Date may 1, 1980. A reactor unit and a nuclear installation which uses said reactor unit and a method of fitting up such an installation. Said installation includes mainly a reactor unit which constitutes a shiftable module formed by a casing and a stand, by a container unit designed to accommodate the reactor unit and by a module for closing the container unit and forming, for example, a swimming bath type storing unit for the used nuclear fuel. The installation of the invention may constitute a nuclear boiler which can be transported to the operation site in the form of an integral assembly or in separate components.

7522 **Electronic ceramics in high-temperature environments.** Searcy, A.W.; Meschi, D.J. (Univ of California, Berkeley, USA). *Journal of the American Ceramic Society;* 65: No. 4, 216-218(Apr 1982).

Simple thermodynamic means are described for understanding and predicting the influence of temperature changes, in various environments, on electronic properties of ceramics. Thermal gradients, thermal cycling, and vacuum annealing are discussed, as well as the variations of ctivities and solubilities with temperature. 7 refs.

7523 **Fuel-rod-retention device for a nuclear reactor.** Hylton, C.L. (to Dept. of Energy). US Patent Application 343,793. 29 Jan 1982. 15p. Contract AC02-78ET34213.

A device is described for supporting a nuclear fuel rod in a fuel rod assembly which allows the rod to be removed without disturbing other rods in the assembly. A fuel rod cap connects the rod to a bolt which is supported in the assembly end fitting by means of a locking assembly. The device is designed so that the bolt is held securely during normal reactor operation yet may be easily disengaged and the fuel rod removed when desired.

7524 **Estimating structural integrity, using the TPFC approach, of annealed type 304 stainless steel plate and pipes containing surface defects.** Reuter, W.G.; Place, T.A. (EGandG, Idaho Falls, Idaho, USA). *International Journal of Pressure Vessels and Piping;* 10: No. 1, 55-67(Jan 1982).

Test results and an evaluation of the two-parameter fracture criterion (TPFC) are presented. The tests were conducted at room temperature with annealed Type 304 stainless steel flat-plate tensile specimens containing triangular-, ellipsoidal- or rectangular-shaped surface flaws, and pressurized pipe specimens with internal or external triangular-shaped surface defects. 8 refs.

2203 Fuel Elements

7525 **Method of assembling and disassembling a control component structure.** Edwards, G.T.; Schluderberg, D.C. (to Babcock & Wilcox Co The). US Patent 4,355,449. 26 Oct 1982. Filed date 1 Jun 1981. vp.

PAT-APPL-269188.

A technique is provided for engaging and disengaging burnable poison rods from the spider in a fuel assembly. The cap on the end of each of the burnable poison rods is provided with a shank that is received in the respective bore formed in the spider. A frangible flange secures the shank and rod to the spider. Pressing the shank in the direction of the bore axis ruptures the frangible flange to release the rod from the spider.

7526 **Rack for storing bundles of nuclear fuel elements.** Bosshard, E. (to Sulzer Brothers Ltd (Switzerland)). US Patent 4,356,062. 26 Oct 1982. Priority date 23 Apr 1979, Switzerland, vp.

PAT-APPL-139343.

The rack has a base plate which is formed with a pattern of holes and tube sections which are located under the holes. Feet are threaded into the tube sections and can be adjusted through the tube sections and plate so as to level the base plate. Hollow bolts can also be threaded into the upper portions of the hollow tubes in order to clamp square support tubes to the base plate. Suitable adjustment means are also provided to adjust each foot.

7527 **Process for loading the reactor cavity of a nuclear reactor.** Brandes, S.; Gutsch, U.; Pesch, H. (to Hochtemperatur-Reaktorbau Gmbh (Germany, Federal Republic Of)). US Patent 4,356,145. 26 Oct 1982. Priority date 11 Jun 1979, German, Federal Republic of (F.R. Germany), vp.

PAT-APPL-157383.

Disclosed is a process for reloading the contaminated empty reactor cavity of a nuclear reactor with spherical operating elements forming the core of a high temperature reactor comprising supplying the operating elements to the reactor cavity first through a central loading tube in the roof reflector of the nuclear reactor to a predetermined load level, the loading tube being extended at the onset of the loading process toward the floor reflector and being adjusted upwardly during continued loading with the rising load level and after reaching the predetermined load level, supplying further operating elements through a plurality of auxiliary loading tubes in the roof reflector of the nuclear reactor in concentric circles about the central loading tube with the loading sequence proceeding circle after circle beginning with the circle closest to the central loading tube.

7528 **Nuclear fuel assembly.** Hosokawa, T.; Maki, H.; Shinbo, K. (to Hitachi Ltd (Japan)). US Patent 4,355,002. 19 Oct 1982. Priority date 28 Oct 1974, Japan, vp.

PAT-APPL-841738.

First nuclear fuel elements in which a fissionable material in which a burnable poison is incorporated is loaded and second nuclear fuel elements in which a fissionable material in which no burnable poison is incorporated is loaded are disposed in a nuclear fuel assembly. Content of the fissionable material in the first nuclear fuel element is less than about 72% of that of the fissionable material in the second nuclear fuel element adjacent to the first nuclear fuel element.

7529 **Migration of large gas-filled pores in potassium chloride due to a temperature gradient.** Lemaire, P.J.; Bowen, H.K. (MIT, Cambridge, MA, USA). *Journal of the American Ceramic Society;* 65: No. 1, 41-48(Jan 1982).

The migration of gas-filled pores in KCl subjected to a temperature gradient occurs by a vaporization-condensation mechanism. In many cases the vaporization step, rather than gas-phase diffusion, can limit the rate of migration. Movement of large (>100 /mu/m), argon-filled pores in pure and Ba-doped KCl was observed using hot-stage microscopy. Velocities of large pores in pure KCl were limited by the diffusion rates of KCl monomers and dimers in argon. This observation is consistent with a model in which the vaporization rate is moderately reduced due to widely spaced surface ledges, but is still rapid with respect to gas-phase diffusion. The velocities of large pores in 10 and 40 ppm Ba-doped samples were significantly lower than those in pure samples. A model was developed which explains these decreased migration rates in terms of impurity poisoning of surface kink sites. The model couples detailed expressions for vaporization kinetics with those for gas-phase diffusion rates. 37 refs.

7530 **Migration of small pores in potassium chloride due to a temperature gradient.** Lemaire, P.J.; Bowen, H.K. (MIT, Cambridge, MA, USA). *Journal of the American Ceramic Society;* 65: No. 1, 49-52(Jan 1982).

Pore migration in KCl crystals subjected to a temperature gradient occurs by a vaporization-condensation mechanism. The behavior of small (<100 /mu/m) pores was observed using hot-stage microscopy. A size-dependent probability of pore motion was noted in which the fraction of mobile pores in a given size range steadily increased with size. Pores larger than /approximately equals/50 / mu/m were always mobile. These observations are explained in terms of the probabilities of pore-dislocation intersections. Screw-type dislocations are found to be essential for proving molecular height surface ledges needed for vaporization and pore motion. The observation that some small pores moved and then stopped is explained by the fact that the vaporization rate becomes very low when the pore-dislocation intersection occurs at the edge of a faceted pore. 13 refs.

2204 Control Systems

REFER ALSO TO CITATION(S) 8513

7531 **(EGG-M—20782) Human factor experimental support.** Meyer, O.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1982. Contract AC07-76ID01570. 9p. (CONF-821037—34). NTIS, PC A02/MF A01. Order Number DE83003251.

From 10. water reactor safety research information conference; Gaithersburg, MD, USA (12 Oct 1982).

Experiments to evaluate human factors in nuclear reactor power plant operations receive engineering support to ensure that the experiment results have significance to safety-related questions. The experiment design is impacted by engineering support which both initiates the experiment (the safety-related question) and defines the form of results that would be significant. The emergency response of the main control room (MCR) crew has current high priority because the study of events at reactor plants in recent years, for example, the accident at Three Mile Island, Unit 2 and the steam generator tube rupture at the Ginna plant, has demonstrated a need to understand and predict the impact on reactor safety of human performance during emergency response.

7532 (GRS—19(8-80), pp 5-9) **Summary of session I.** Jervis, M.W.; Beraha, D. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The contribution in the first session centered on the operational experience gained up to now with surveillance systems and on the design characteristics of such systems.

7533 (GRS—19(8-80), pp 14-26) **Evolution of computer-based surveillance, control and man-machine communication systems in nuclear power stations.** Wilkinson, H.M. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Reactor surveillance systems, man-machine communication, control methods and system relibility have steadily improved with successive designs. These improvements have been dramatic. Operational results from nine power-reactor units and preliminary results from 12 more units in various phases of implementation are now becoming available. The scope of the improvements ranges from the first design which used only lantern type displays to the latest which uses 18 colour cathode ray tubes (CRT). The operator can bnow scan a parallel presentation of annunciator messages, bar charts and graphical presentations.

7534 (GRS—19(8-80), pp 29-42) **Data processing and data display in Electricite de France PWR 1300 MW nuclear power plants.** Hermant, C.; Guesnier, G. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

In E.D.F. PWR 1300 MW nuclear power plants, digital control is achieved by automatic devices using electronic integrated components with programmed logic. These modular systems have been designed by CGEE-ALSTHOM under E.D.F. requirements and are named CONTROBLOC. They actuate digital control of 1300 MW unit equipment and also provide logic indications and warnings on conventional displays and on alphanumerical colour CRT's. Moreover, a dual-computer system designed by CERCI-SINTRA centralizes logic and analog data. Logic data generated by CONTROBLOC cabinets are sent to computer on multiplexed lines. Analog data are transmitted conventionally or by digital means. The paper describes the design of that system and explains the features which facilitate control and monitoring of the whole generating unit.

7535 (GRS—19(8-80), pp 45-56) **Detection of plant abnormalities by suitable control room lay-out, equipment and possibilities for computerized operator support systems.** Helske, J; Wahlstroem, B. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The control rooms at Loviisa nuclear power stations (2 PWR) are described.

7536 (GRS—19(8-80), pp 59-67) **Augmenting operator guide for routine and emergency operations.** Ojha, K.P. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper reviews the parameters displayed and their layount at Rajasthan Atomic Power Station. Additional displays provided and more under consideration are described.

7537 (GRS—19(8-80), pp 71-83) **Demonstration and verification of on-line core evaluation system in the startup test of heavy water reactor, FUGENug.** Kaneto, K.; Ohteru, S.; Natori, H. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Validity of FUGEN on-line core performance evaluation system, ATROPOS, was verified through the startup test. The main verification results are as follows; (1) The estimation error of the power distribution was less than 3% at any power levels. (2) The differences were about 4% between channel flow rate converted from the measured pressure drop and that estimated by ATROPOS. (3) The uncertainties of the thermal operations limits were evaluated to be about 6%. (4) The core thermal power can be predicted accurately and the prediction depends on the Dopper reactivity coefficient to be used. (5) The prediction errors of the thermal operation limits were less than 4% within the specified region. (6) The whole core power distribution was predicted with about 6% error excluding core peripheral segments.

7538 (GRS—19(8-80), pp 87-98) **Five years operational experience of a mini-computer based auto-control system on the Windscale Advanced Gas Cooled Reactor.** Eales, B.; Smith, I.C. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

For the two 600 psi experimental loop facilities it was decided to use an auto-control system based on a mini-computer. In order to ease the job of re-programming for each new set of calculations that part of the software was implemented in BASIC. The scanning routines and other routines controlling the interfaces to the actuators were written in assembler language and were not designed to be modified between experiments. Data from the two ex-

perimental loop facilities is also fed into a separate minicomputer based data logging and alarm system which serves the whole reactor system. For ultimate safety protection the loops are also connected into the completely independent analogue reactor trip system.

7539 (GRS—19(8-80), pp 101-112) **On-line process computer application for operator's aid in Toshiba BWR.** Kawahara, H.; Monta, K.; Itoh, M. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper describes following three systems which are effective to reduce operator's burden. Most popular application for this area will be the display system with colour CRT techniques. PODIA (Plant Operation by Displayed Information and Automation) system which has been developed by Toshiba is a typical one of this application. Currently, we are reviewing this PODIA system for the use of operator's guide even in abnormal occurence. Computer application to plant diagnosis is another one of recent interest. The earliest abnormality detection and prompt countermeasure against failure development into a large scale accident are of greatest importance for nuclear plant safety. The data base computer and high speed I/O system can analyze a large number of plant noise signals which contains information of earliest abnormality of plant systems and equipments. Load following operation of nuclear power plant seems to be a real necessity in near future. Even though BWR plant can control its power easily with recirculation flow rate change, the consideration should be given to Xenon transient and reactor status such as fuel burn-up, power distribution and control rod pattern. To assist plant operation in load following operation, mini-computer system and a μ-computer based automatic reactor power regulation system has been developed.

7540 (GRS—19(8-80), pp 115-127) **Model surveillance program based on regulatory experience.** Conte, R.J. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

A model surveillance program is presented based on regulatory experience. The program consists of three phases: Program Delineation, Data Acquistion and Data Analysis. Each phase is described in terms of key quality assurance elements and some current philosophies is the United States Licensing Program. Other topics include the application of these ideas to test equipment used in the surveillance progam and audits of the established program. Program Delineation discusses the establishment of administrative controls for organization and the description of responsibilities using the 'Program Coordinator' concept, with assistance from Data Acquisition and Analysis Teams. Ideas regarding frequency of surveillance testing are also presented. The Data Acquisition Phase discusses various methods for acquiring data including operator observations, test procedures, operator logs, and computer output, for trending equipment performance. The Data Analysis Phase discusses the process for drawing conclusions regarding component/equipment service life, proper application, and generic problems through the use of trend analysis and failure rate data.

7541 (GRS—19(8-80), pp 209-211) **Summary of session III.** Freymeyer, P.; Ehrenberger, W. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

7542 (GRS—19(8-80), pp 215-231) **Disturbance analysis system for on-line power plant surveillance and diagnosis.** Meijer, C.H.; Frogner, B.; Long, A.B. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper addresses a disturbance analysis system (DAS) for on-line power plant surveillance and diagnosis that allows operating personnel to assess in real-time occurring disturbances in terms of inherent character, cause, potential effect on the operational behaviour of the plant, and corrective actions. The system is computer-based and utilizes disturbance analysis algorithms based on information filtering, cause-consequence analysis and quantitative modeling techniques. A prototype system operating on-line and in real-time was developed and demonstrated. The demonstration utilized the C-E PWR Training Simulator and included the simulation and analysis of a selected number of disturbances in the feedwater and component cooling system, and some typical TMI-2 related events. An evaluation of the effectiveness of the DAS in terms of the performance of plant operating personnel in handling plant disturbances without and with the utilization of the DAS, is discussed in some detail.

7543 (GRS—19(8-80), pp 235-246) **Development of plant operation monitoring system for nuclear power plants.** Yamazaki, K.; Kawai, K.; Hashimoto, Y.; Suzuki, M.; Izumi, M.; Kato, K.; Kiguchi, T.; Kobayashi, S.; Yanai, K.; Iida, H. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

A Plant Operation Monitoring System by computer based console, which is one of functions in the NUCAMM-80, is mainly described. The aims of the Plant Operation Monitoring System are: (1) to detect anomalies of the plant at an early stage, (2) to give information on their causes or locations, and (3) to give information on corrective actions.

7544 (GRS—19(8-80), pp 249-260) **Man-machine communication in experimental reactor control system.** Buerger, L.; Vegh, E. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper describes the man-machine interface of an experimental control system of a WWR-SM research reactor.

7545 (GRS—19(8-80), pp 263-281) **Functions and design characteristics of the STAR disturbance analysis system.** Buettner, W.E.; Felkel, L.; Grumbach, R.; Owre, F.; Thomassen, B. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The experimental version of the STAR system has been installed at the Grafenrheinfeld Nuclear Power Plant. The paper outlines the functional requirements and the functional layout of the state of the art disturbance analysis system. To supply some orientation for potential users, the minimum hardware equipment is shown for the on-line system. There are special time constraints imposed on the performance of the analysis. These are different for each plant subsystem to be analyzed, the paper also singles out those plant subsystems which are particularly apt for disturbance analysis. Another topic will be user aspects in handling the disturbance analysis system as well as ergonomic considerations. A practical example of a plant system, a disturbance and the on-line analysis of this disturbance is presented.

7546 (GRS—19(8-80), pp 285-300) **Analytical methods and performance evaluation of the STAR application in the Grafenrheinfeld nuclear power plant.** Felkel, L.; Grumbach, R.; Zapp, A.; Owre, F.; Trengereid, J.K. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The STAR disturbance analysis system is now installed in the Grafenrheinfeld nuclear power plant and is connected, on-line, to the plant supervisory computer. This paper describes the actual system set-up. The system is now being subjected to a long term performance evaluation. Automatic tools have been designed to

partly support performance evaluation; these will be shown in this paper. Another topic is the on-line analysis method used in the STAR DAS. It is also shown how the user may program the system to meet his specific ergonomic requirements.

7547 (GRS—19(8-80), pp 303-319) **On-line alarm analysis using decision table technique.** Baldeweg, F. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

A procedure for the analysis of event trees is described, which has been used to develop a programme system for the on-line alarm analysis in a nuclear power plant. The event tree can be considered as the model of the so called basic system to be surveyed. The procedure bases on the assumption of the state of the basic system to be a tupel. It takes into account, that individual measuring points are defect or deficiency of individual events can happen. The programme system is being realized on a process computer system - consisting of mini- and microcomputer - and hitherto tested for the simulated break down system of the nuclear power plant.

7548 (GRS—19(8-80), pp 351-361) **Computerized system for evaluation of the status of a protection system.** Nedelik, A.; Roggenbauer, H. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Evaluation of the status of the protection system includes specific instructions in the operation manner.

7549 (GRS—19(8-80), pp 365-379) **Monitoring readiness of safety relevant devices in nuclear power plants by means of CRT-colour displays.** Haubert, R.; Stokke, R. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The development of an information system for monitoring readiness of safety relevant devices is encouraged by the requirements of KTA-rule 3501 (DIN 25434), which states in section 4.9.1.1. 'A display shall be provided for giving a survey of the condition of the components of the reactor protection system and the active engineered safeguards including their energy and auxiliary media supplies'. In the first stage of the development which was reported at the Enlarged Halden Programme Group Meeting in Loen, Norway, 5th-9th June, 1978, only the components of parts of a BWR-protection system were considered and no display was provided. This paper outlines the next step in the development which comprises implementation of the active engineered safeguards into the system and development of a display system based on a colour CRT-screen. A prototype of this computer-based system for monitoring of protection systems has been established, and it is planned to demonstrate this prototype system using the computer equipment at GRS, Garching (orig./HP).

7550 (GRS—19(8-80), pp 383-392) **Surveillance systems under development at Electricite de France.** Cormault, P. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper is providing an overview of some projects recently developed or under development at EDF in the field of surveillance of particular plant processes or subsystems. The first system described is devoted to the on-line surveillance of protection sensors response time. Experience gained both in laboratory experiments and in plant testing leaded to the implementation of a microprocessor based on-line monitor. The second surveillance system described in a fast transient monitor designed for turbine and generator surveillance and disturbance analysis.

7551 (GRS—19(8-80), pp 395-405) **Acoustical signal processing for light water reactor diagnosis.** Hashimoto, Y.; Kawai, K.; Suzuki, M.; Izumi, S.; Michiguchi, Y.; Yamada, K.; Joge, T. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Acoustical signal processing methods for the detection of loose parts and abnormal vibration of reactor internals are investigated. The study involved extracting features of impact and friction sounds caused by anomalous phenomena in a reactor from accelerometer signals which are contaminated by background noise. For this purpose, three methods are investigated. These are: 1) a demodulation method; 2) impact period analysis; and 3) amplitude-time difference method. The effectiveness of these methods are demonstrated through mockup testing and in-plant experiments for simulated impacts in a boiling water reactor.

7552 (GRS—19(8-80), pp 409-437) **PWR neutron noise surveillance: Noise sources and their effects.** Assedo, R.; Bernard, P.; Cloue, J.; Carre, J.C.; Epstein, A. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

In this paper, we present an analysis of the potential or actual noise sources and experimental results of neutron noise measurements performed on three differently designed reactors. The consequences of these investigations are then applied to define principles of surveillance.

7553 (GRS—19(8-80), pp 441-454) **Application of pattern recognition techniques to the detection of the Phenix reactor control rods vibrations.** Zwingelstein, G.; Deat, M.; Le Guillou. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The incipient detection of control rods vibrations is very important for the safety of the operating plants. This detection can be achieved by an analysis of the peaks of the power spectrum density of the neutron noise. Pattern recognition techniques were applied to detect the rod vibrations which occured at the fast breeder Phenix (250MWe). In the first part we give a description of the basic pattern which is used to characterize the behaviour of the plant. The pattern is considered as column vector in n dimensional Euclidian space where the components are the samples of the power spectral density of the neutron noise. In the second part, a recursive learning procedure of the normal patterns which provides the mean and the variance of the estimates is described. In the third part the classification problem has been framed in terms of a partitionning procedure in n dimensional space which encloses regions corresponding to normal operations. This pattern recognition scheme was applied to the detection of rod vibrations with neutron data collected at the Phenix site before and after occurence of the vibrations.

7554 (GRS—19(8-80), pp 457-481) **Simulation of fuel element thermal hydraulics for sensitive monitoring of coolant flow.** Edelmann, M. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The sensitivity of outlet temperatures for cooling disturbances can be improved significantly by eleminating temperature noise and variations of the temperature rise of a subassembly due to inlet temperature and power noise or control of the reactor power level. This has been demonstrated at the KNK II. The different types of KNK fuel elements were modeled by individual combinations of two first-order low-pass filters, one for the fuel element and one for the thermocouple. Using a neutron detector signal as input for these filters provides simulated outlet temperature signals for comparison with the measured signals. Under stationary conditions

of reactor operation these signals agreed within less than 1 K. For non-stationary conditions a more general model of the fuel element was applied. In this model time-dependent thermohydraulic parameters could be used. In this way a cooling disturbance consisting of gas bubbles in the sodium was simulated. A sensitivity study showed that gas bubbles of 1% of the sodium volume in the fuel region could be detected at KNK II in spite of the power drop caused simultaneously by the negative sodium void effect.

7555 (GRS—19(8-80), pp 485-496) **Detection of coolant disturbances in the fuel elements of an LMFBR by temperature fluctuation analysis.** Weinkoetz, G.; Martin, H.; Krebs, L. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Sodium temperature noise measurements were performed at the coolant fluid outlets of an electrically heated 169-rod bundle and also a 28-rod bundle, with different partially blocked coolant sections. On both test assemblies, a flow mixer was installed downstream of the bundle fluid exit plane. For all tests, measuring planes with three-wire thermocouples containing both steel-sodium and chromel-alumel junctions were located on the upstream and downstream sides of the flow mixer. Statistical parameters such as the root mean square (RMS) and the power spectral density (PSD) of temperature fluctuations were investigated. The influences of flow velocity, heat flux, thermocouple cut-off frequency, and different blockage sizes on these statistical parameters were analysed. Moreover, an essential result of interpretation of the experiments is that a characteristic geometrical bundle coefficient was found which indicates coolant channel disturbances only, independent of the operational conditions of the bundles such as heat flux and flow velocity.

7556 (GRS—19(8-80), pp 499-508) **Use of the noise diagnosis for surveillance of particular disturbing processes in a pressurized water reactor.** Liewers, P.; Schumann, P.; Weiss, F.P. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Up to now the automatic application of noise diagnosis has been impossible because of the experimental character of noise methods and of the probabilistic character of their results. The importance of diagnostic results has induced the idea to implement a rough surveillance monitoring of known disturbing processes, which only gives the output information 'normal' or 'suspicious' to the operator. Indicated suspicious states must be investigated in more detail by noise specialists. A few such monitors are being tested now. Their results stored in a data record office also serve as recommendations for the next revision period.

7557 (GRS—19(8-80), pp 511-523) **Operational guidance equipment for fuel handling system.** Sato, M.; Kameda, A.; Sato, T.; Yoneda, Y. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

At the Experimental Fast Breeder Reactor 'Joyo', fuel handling operation, which includes spent fuel transfer from the core to the in-vessel storage rack and storage rack to the transfer rotor, and new fuel transfer to the opposite direction, are performed almost every two months. No erroneous fuel handling of the operator are allocated in these processes. For this purpose, an equipment has been introduced to the fuel handling system. This equipment provides the following functions. 1) Monitoring of the operation of charging between fuels in the core and in the storage rack in the reactor vessel. 2) Monitoring of the operation of fuel transportation between the storage rack in the reactor vessel and the transfer rotor. 3) Operation guidance for each fuel handling procedure. 4) Confirmation of fuel appropriate grappling by weight detection. 5) Memorizing the fuel adressing status in the core and the storage racks, and updating these status according to the process. These functions are realized by a process computer.

7558 (GRS—19(8-80), pp 527-551) **Estimation of local power in a PWR core from gamma rays measurements.** Beraud, G.P.; Bonnemay, A.; Le Dieu de Ville, A.; Nimal, J.C. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

In order to improve power distribution determination several methods and instrumentations are under development, particular attention is given to fixed incore using gamma thermometer. The following parts review a brief description of gamma thermometer principle and advantages, give some comments about data treatment and more details about gamma signal interpretation.

7559 (GRS—19(8-80), pp 563-574) **Simulation study on the diagnosis system of nuclear power plant operation.** Wakabayashi, J.; Fukumoto, A. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The study is concerned with the early detection of insignificant anomalies and estimation of the anomaly source during operation. From our previous studies, we considered that the practical diagnosis system would be consisting of three blocks, i.e. 1) detection and classification of the anomalous state, 2) estimation of the primary cause of detected anomaly and 3) storage of past detected signals. The linear discriminant function technique is applied in block 1 and the Kalman-filter technique is applied in block 2. The Kalman-filter corresponding to the individual anomalous state (category) classified by block 1 is derived from the simplified dynamic model which is identified beforehand for each category using a set of training data generated by the plant simulator. The applicability of this diagnosis system in an actual plant is examined using a hybrid computer, where a 450 MWe PWR plant simulator was composed by the analogue computer and a diagnosis system was composed by a digital computer. The computer experiments were made for several presumed anomalous states, i.e. 1) reactivity change, 2) decreases of the primary coolant flow, 3) change of the feed water flow and 4) change of the demand power generation.

7560 (GRS—19(8-80), pp 577-581) **Dynamic classification and reduction of alarms in computer-based information systems.** Cerny, R. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The experience, gained in operation of conventional power unit has led us to devise dynamic classification of alarms as computer function which reduces the number of alarm messages presented to the operator without loss of meaningful information. The conditions for realization were: 1) minimal alteration of existing programming system; 2) simple algorithmic solution so that adoption of the function for all input variables would not adversely affect the throughput of the computer system; 3) the suppressed data must be available to the operator on demand. In accordance with this the alarms are classified in hierarchical priority order and alarm messages are derived only from alarms of highest significance. The suppressed data and other related information from predefined groups of variables, which may be presented to the operator on demand.

7561 (GRS—19(8-80), pp 585-603) **Use of flow models for design of plant operating procedures.** Lind, M. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

It is shown how operating procedures can be structured into logically consistent parts by a decomposition into sequential and concurrent action sets. The decomposition is shown to originate from the topology of the pattern of material and energy flow in the plant, and to the nature of the specific control task considered. This analysis provides valuable information of how plant structure can be used explicitly in procedure design. It is shown how a category of models called flow models developed by the writer, can be used

to represent flow topology in material and energy processing plants. Flow models will be used as a way of dealing with plant topology in procedure design. The observation which leads to the consideration of flow models for procedure design is that e.g. start-up procedures for apparently dissimilar plant components as pumps and boilers show some common structural features. The reason for this is that the components are functionally equivalent in certain phases of their operation. Functional equivalence of components or systems can be expressed by using the language of flow models.

7562 (GRS—19(8-80), pp 607-627) **Verification test for on-line diagnosis algorithm based on noise analysis.** Tamaoki, T.; Naito, N.; Tsunoda, T.; Sato, M.; Kameda, A. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

An on-line diagnosis algorithm was developed and its verification test was performed using a minicomputer. This algorithm identifies the plant state by analyzing various system noise patterns, such as power spectral densities, coherence functions etc., in three procedure steps. Each obtained noise pattern is examined by using the distances from its reference patterns prepared for various plant states. Then, the plant state is identified by synthesizing each result with an evaluation weight. This weight is determined automatically from the reference noise patterns prior to on-line diagnosis. The test was performed with 50 MW (th) Steam Generator noise data recorded under various controller parameter values. The algorithm performance was evaluated based on a newly devised index. The results obtained with one kind of weight showed the algorithm efficiency under the proper selection of noise patterns. Results for another kind of weight showed the robustness of the algorithm to this selection.

7563 (GRS—19(8-80), pp 647-665) **Software verification in on-line systems.** Ehrenberger, W. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Operator assistance is more and more provided by computers. Computers contain programs, whose quality should be above a certain level, before they are allowed to be used in reactor control rooms. Several possibilities for gaining software reliability figures are discussed in this paper. By supervising the testing procedure of a program, one can estimate the number of remaining programming errors. Such an estimation, however, is not very accurate. With mathematical proving procedures one can gain some knowledge on program properties. Such proving procedures are important for the verification of general WHILE-loops, which tend to be error prone. The program analysis decomposes a program into its parts. First the program structure is made visible, which includes the data movements and the control flow. From this analysis test cases can be derived that lead to a complete test. Program analysis can be done by hand or automatically. A statistical program test normally requires a large number of test runs. This number is diminished if details concerning both the program to be tested or its use are known in advance.

7564 (GRS—19(8-80), pp 669-685) **Operator-interactive surveillance method of periodic inspection of active engineered safety system of WWER 440 type reactors.** Hollo, E. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

Functionally the engineered safety system (ESS) can be devided into two main parts: the emergency core cooling system and the pressure reduction system of hermetic rooms. Both parts consist of passive and active subsystems, their availability has periodically to be checked during the normal operation of the nuclear power plant. The passive sub-systems are checked during the annual shutdown period of the reactors when their reloading having been finished, the active subsystems may and have to be checked during the normal operation of the plant, too. This can be performed by the appropriate execution of the operating start-up instructions concerning these systems, while the effectiveness of their checking can be increased by computerized data processing. A simple method resulting satisfactory information for the operator to qualify the ESS is presented.

7565 (GRS—19(8-80), pp 707-723) **Modern approach for the realisation of the man-machine information system.** Martin, D.; Grensemann, D. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The tool for man-machine communication has been given the name VISCOMP-VISual COmmunication Man-Process. Dependent on the project implementation phase VISCOMP functions either autonomously (planning and definition phases) or in conjunction with a data acquisition system during the operational phase on the plant. The relationship of the required components to the project phases is illustrated.

7566 (GRS—19(8-80), pp 727-738) **Analysis and presentation of annunciations in nuclear power plants.** Frischenschlager, F. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper describes an analytical method - within the overall control room conception - which ensures an evaluation of all alarms and status indications for a correspondingly selected output. This procedure - using modern computer based output devices for process supervision - is a possibility to deal with the high quantity of relevant information, that is approximately 4500 alarms and approximately 2000 status indications. Based on the activity characteristics and responsibilities of the control room personnel the process and control system data are classified and subdivided into relevant groups. An overview of evaluated quantities of alarms and status information for each of the defined subgroups is given. The paper concludes with a description of the design characteristics of the layout of the communication modules with CRT-displays.

7567 (GRS—19(8-80), pp 741-755) **Coordination of operator supporting systems and procedures.** Bjorlo, T.J.; Trengereid, J.K. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The paper presents the design philosophy which forms the basis for the work at the Halden Reactors Project to synthesize the accumulated knowledge and results from past and current efforts into prototype solutions for operator support. Some examples of specific surveillance systems are given. The development of such systems involves both technological, methodological, and human engineering aspects. This paper has emphasized the interfaces to the users, i.e., the operator communication and the procedural aspects of such surveillance systems.

7568 (GRS—19(8-80), pp 815-828) **Good operator-process relation research in Creys-Malville project.** Decuyper, J.; Reynaud, S.; Hoepner, A.; Rolland. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

This paper deals with the approaches undertaken by NERSA in order to get an optimal man-machine interface design, both in normal and in abnormal operation conditions at the Super-Phenix Reactor. The main features followed are: 1) adopting of a control system allowing the easiest process control and operating (this aspect has been presented recently in a paper at a previous meeting, see ref. 1, and will therefore not be exposed); 2) design of the control room according to the operational simulation data and the control and instrumentation devices which are to be installed; 3) research of optimal operating procedures, mainly during load variations and during abnormal operating conditions; 4) operator's training.

7569 (GRS—19(8-80), pp 831-834) **Outlook for the use of computers for protection systems and automatic control in nuclear power plants.** Patterson, E.S. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The technological power of computers has rapidly increased since 1976; however, the issues of 1976 centering upon the detection of software errors are still with us. Virtually no progress has been made in proving that software errors absolutely do or do not exist. The rapidly rising demand for the reduction in the probability for human error cannot be met without extensive use of computers for control and safety related functions. The software error issues of 1976 must be resolved if we are to significantly reduce human error.

7570 **(Juel-Spez—127) Studies concerning the power distribution control and management of xenon oscillations in the PNP-3000 high-temperature pebble-bed reactor.** Mertens, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Sep 1981. 166p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE82750660.

This paper is concerned with the investigation of possibilities relating to a power distribution control with core rods and alternatively with rods in the side reflector. For this purpose, the spatial effect of unsymmetric control measures is calculated and discussed. Modelling of the reactor in the computer programmes used is described in detail, emphasis is being placed on the representation of control rods inserted at different depths in horizontal computation models. The dynamic behaviour of the reactor in connection with azimuthal xenon oscillations is calculated in a two-dimensional manner, covering exactly the complex core design in detail with position-dependent power feedback on the neutron spectra. On the basis of results obtained using the control theory, measures are also simulated realistically allowing for operational boundary conditions for the spatial profile of the gas outlet temperature in addition to a simple concept for time-optimal controls.

7571 **Simulation and control of a nuclear electric power station.** El-Metwally, M.M. (Cairo Univ., Egypt); El-Nahas, I.A.; Tawfik, M.A.H. pp 800-804 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

A non-linear mathematical model in the state variable form has been used for investigating the dynamic behavior of a nuclear power plant. The effect of the system control parameters is studied. The analysis gives insight into the dynamic behavior leading to recommendations for system improvement of dynamic performance.

7572 **Transient design considerations for LMFBR control assembly rods.** Coffield, R.D. Jr.; Markley, R.A.; Miller, J.V. (WARD, Madison, PA 15663). *Transactions of the American Nuclear Society;* **35**: 664-665(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7573 **Comparisons of design code predictions with LMFBR blanket heat transfer tests results.** Engel, F.C.; Markley, R.A.; Minushkin, B. (WARD, Madison, PA 15663). *Transactions of the American Nuclear Society;* **35**: 665-668(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7574 **Power distribution and control element reactivity changes in Advanced Test Reactor due to beryllium reactor redesign.** Gregory, W.D.; Zimmerman, W.L. (EG&G Idaho, Idaho Falls, ID 83401). *Transactions of the American Nuclear Society, Supplement;* **32**: 10-11(1979). (CONF-790807—).

From Topical conference on reactor operating experience; Arlington, TX, USA (5 Aug 1979).

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 7553, 7584, 8332

7575 (GRS—18, pp 99-106) **Improved models of the atmospheric distribution of radioactive substances and their effects on humans.** Huebschmann, W.; Jacobi, W. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

As a part of the protection of man against the effect of ionizing radiation mathematical models perform among other things the task to detect the diffusion of radioactive substances in the environment and their effect on man in a reliable way and to render the risk for man calculable. In this matter the principle of conservativity is concerned: where uncertainties exist assumptions are made in a way that the final result - e.g. the radiation dose - is appraised conservatively, i.e. upwards. The aim of the reserach is to minimize such uncertainties in order to attain an estimation of the radiation effect which is as realistic as possible. However, there are quite important uncertainties with regard to the estimation of the consequences of single emissions of radioactive substances, perhaps caused by incidents.

7576 **(NUREG/CR—2727-Vol.2) Ecological studies of wood-boring bivalves in the vicinity of the Oyster Creek Nuclear Generating Station. Progress report, December 1981-February 1982.** Hoagland, K.E.; Crocket, L. (Academy of Natural Sciences of Philadelphia, PA (USA). Dept. of Malacology). Aug 1982. 35p. NTIS, PC A03/MF A01 - GPO $4.50. Order Number DE83900102.

The species composition, distribution, and population dynamics of wood-boring bivalves are being studied in the vicinity of the Oyster Creek Nuclear Generating Station, Barnegat Bay, New Jersey. Untreated wood test panels are used to collect organisms at 12 stations. Physiological tolerances of 3 species are also under investigation in the laboratory. Competition among the species is being analyzed. In the winter of 1981, the generating station experienced a prolonged outage. The reproductive cycle of the shipworms was not extended. Teredo bartschi was very abundant at one station in Oyster Creek and moderately abundant at a second, but did not exist elsewhere in Barnegat Bay. Some specimens of Teredo bartschi contained larvae in the gills in February. According to laboratory experiments, Teredo navalis is able to remain active at temperatures as low as 4°C, whereas T. bartschi ceases activity (withdraws its siphons) at about 13°C. 12 tables.

7577 **Predicting visual aesthetic benefits of alternative closed-cycle cooling systems.** Currie, J.W.; Adams, R.C.; Herbert, J.; Shikiar, R. (BNWL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **35**: 48-49(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 7544, 7574, 7607, 7654, 7657

7578 **(DOE/ER/01560—16) Nuclear Reactor Laboratory annual report, fiscal year 1981-1982.** Cashwell, R.J. (Wisconsin Univ., Madison (USA). Nuclear Reactor Lab.). 1982. Contract AC02-76ER01560. 14p. NTIS, PC A02/MF A01. Order Number DE82021589.

Information related to the use of the UWNR reactor is presented concerning instructional use by the Nuclear Engineering Department; reactor sharing program; utility personnel training; sample irradiations and neutron activation analysis services; changes in personnel, facility, and procedures; and results of surveillance tests.

7579 **(PB—82-209883) Fuel plate temperatures following shutdown of the Scottish Universities Research and Reactor Centre Reactor: theoretical and experimental results.** Riley, J.A.; Donald, S.R. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). 1973. 48p. NTIS, PC A03/MF A01.

A mathematical model has been developed that predicts the fuel plate temperature behavior of the Scottish Universities Research Reactor following a 'scram' shutdown in which the core water is 'dumped' immediately on shutdown. This model predicts the maximum fuel plate temperature variation with time after shutdown from a given set of steady state reactor operating conditions.

7580 **Thermal hydraulics of handling FFTF fuel in sodium and argon, comparing test results with calculated.** Guzek, J.C.; Ingham, J.G. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **35**: 668-669(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7581 **Sensitivity and A Priori uncertainty analysis of the CFRMF central flux spectrum.** Ryskamp, J.M.; Anderl, R.A.; Broadhead, B.L.; Ford, W.E.; Lucius, J.L.; Marable, J.H.; Wagschal, J.J. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **35**: 556-558(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

7582 **Instrument calibration program for startup of FFTF.** Swanson, C.D. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society, Supplement;* **32**: 36-37(1979). (CONF-790807—).

From Topical conference on reactor operating experience; Arlington, TX, USA (5 Aug 1979).

2208 Propulsion Reactors

7583 **Guarantee of quality for the steel hoops of the refueling machine of the nuclear ship OTTO HAHN by way of a special procedure with ultrasonic.** Neumann, H.; Worschech, R. Geesthacht-Tesperhude, Germany, F.R.; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1982). 5p. (In German). (GKSS—82/E/14).

The basic overhaul and renewal of the refueling machine constructed 1965-1967 for the reactor system of the nuclear ship OTTO HAHN required among other things the replacement of the lifting hoops which are necessary for raising the fuel elements and guiding the gripping device. These steel hoops are the critical components of the refueling machine. Therefore the quality assurance of the material was articularly specified. One way of ensuring this guarantee of quality is to carry out tests involving the use of ultrasonic equipment as desired and applied here. The process is explained and its application with the results obtained is described.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 8227, 8243, 8409

7584 **(BMI-SR—198a) Surface concepts preliminary study on alternative concepts of the underground construction of nuclear power plants.** Bittner, A.; Falk, H.J.; Streer, G. (Dyckerhoff und Widmann A.G., Muenchen (Germany, F.R.). Abt. Kernkraftwerksbau). Jun 1981. 222p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE82751044.

The reactor building for a 1.300 MWe DWR with one- and two-sheet secondary shielding with sheets of different strength was investigated by taking different conditions of the foundation into account. The analysis is based on data obtained at selected points of the secondary shielding (impact of an aircraft) and at the component parts within the internal missile protection cylinder.

7585 **(BNL—31908) Nuclear regulation and safety.** Hendrie, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 12p. (CONF-820802—48). NTIS, PC A02/MF A01. Order Number DE83002219.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

Nuclear regulation and safety are discussed from the standpoint of a hypothetical country that is in the process of introducing a nuclear power industry and setting up a regulatory system. The national policy is assumed to be in favor of nuclear power. The regulators will have responsibility for economic, reliable electric production as well as for safety. Reactor safety is divided into three parts: shut it down, keep it covered, take out the afterheat. Emergency plans also have to be provided. Ways of keeping the core covered with water are discussed. (DLC)

7586 **(DOE/NE/37254—1) Debris-bed cooling following an HCDA in a fast reactor. Annual progress report.** Abdel-Khalik, S.I. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 1 Oct 1982. Contract AC02-82NE37254. 31p. NTIS, PC A03/MF A01. Order Number DE83002448.

Portions of document are illegible.

Natural convection within simulated core debris beds has been investigated experimentally and numerically. The objectives of this research have been: (1) to develop a three-dimensional transient model for analyzing single-phase cooling of debris beds; (2) to validate the model using out-of-pile simulant experiments which measure the detailed structure of the convection cells within the bed as well as integral heat transfer rates; and (3) to apply the model to typical core debris beds over a wide range of parameters in order to determine the relative importance of conduction and convection in sodium-cooled debris beds. The bed has been simulated using directly heated two-dimensional packed tube bundles of different particle diameters, bed loadings, porosities, heat generation rates, and overlaying fluid layer heights. Detailed velocity and temperature profiles within the bed and overlaying fluid have been measured using particle tracing techniques and Mach-Zehnder interferometry. Measurements of the downward and upward power fractions and Nusselt numbers over a wide range of experimental variables have been made. The data have been compared with predictions of the transient three-dimensional natural convection computer code COMMIX-1A. 14 figures.

7587 **(EGG-M—21282) Semiscale program FY 1982-1983 highlights.** Shimeck, D.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1982. Contract AC07-76ID01570. 8p. (CONF-821037—35). NTIS, PC A02/MF A01. Order Number DE83002997.

From 10. water reactor safety research information conference; Gaithersburg, MD, USA (12 Oct 1982).

Portions of document are illegible.

Experiments and analyses conducted by the Semiscale Program in the past year have encompassed a number of water reactor safety issues. Efforts continued on completing the analysis of extensive natural circulation cooling experiments performed in FY-1981. Effort was also extended toward analyzing data from numerous small-break loss-of-coolant experiments performed since the TMI-2 accident. Recent results from this effort have highlighted the value of experimental results in validating computer code capabilities. In terms of new experimental work, three test series were performed: an intermediate break series, secondary side feedwater and steam line breaks, and primary coolant system feed and bleed experiments. Each is briefly reviewed.

7588 **(EGG-M—24782) RELAP5 application to integral experiments.** Ransom, V.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1982. Contract AC07-76ID01570. 12p. (CONF-821037—33). NTIS, PC A02/MF A01. Order Number DE83003250.

From 10. water reactor safety research information conference; Gaithersburg, MD, USA (12 Oct 1982).

RELAP5 is a one-dimensional light water reactor (LWR) transient analysis code. The outstanding features of the code are its versatility, fast running, and ease of use. The released version of the code, RELAP5/MOD1, is available from the National Energy

Software Center and is being maintained. Error corrections and minor improvements are added to the code periodically as updates (cycle 18 contains the latest updates to the code). The RELAP5/MOD1 code contains the necessary models for simulation of LWR depressurization and operational transients. This version of the code is particularly well suited to simulation of small break loss-of-coolant accidents (LOCAs) and has been used extensively at the Idaho National Engineering Laboratory (INEL) in support of the Semiscale and LOFT testing programs. The major limitation of RELAP5/MOD1 is the lack of reflood modeling capability, specifically the nonequilibrium heat transfer process in the subcooled boiling and post-CHF regimes. During 1982 new modeling capabilities were completed in addition to the maintenance activities related to RELAP5/MOD1. An interim version of the code, RELAP5/MOD1.5, containing most of the new features was released to the NRC for use by NRC contractors in August of 1982.

7589 **(EPRI-NP—2722) Characterization of the contamination in the TMI-2 reactor coolant system. Final report.** Cunnane, J.C.; Nicolosi, S.L. (Battelle Columbus Labs., OH (USA)). Nov 1982. 82p. NTIS, PC A05/MF A01. Order Number DE83900578.

The objective of this work was to help characterize the contamination on the primary system surfaces of TMI-2 in support of decontamiation process selection and planning. The approach adopted was to use available analytical techniques or models to describe the release of contamination from the core region and its subsequent transport and deposition in the primary coolant loops. While the results obtained are subject to some uncertainty, they do lead to significant conclusions for decontamination process selection and planning.

7590 (GRS—18, pp 23-38) **Studies on methods and systems to improve communication between man and machine in nuclear power plants.** Bastl, W. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

The most important results of the research project are explained and analyzed: 1) Special measuring techniques for on-line control of the mechanical state of the reactor plant; 2) use of process computers for a best representation of the state of plant, for alarm condensation and for alarm analysis; 3) use of the display technique in the observatory; 4) new observatory concepts, and 5) human factors in nuclear power plants.

7591 (GRS—18, pp 4-17) **Reactor safety research project of the Federal Government.** Krewer, K.H. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

The research program is split up in four subjects, i.e. - measures for increasing the operational reliability and for reducing the probability of incidents to occur, analysis of incident progresses and their effects, analysis of the radiation load caused by operation and incidents, analysis of the risk of nuclear power plants.

7592 (GRS—18, pp 18-22) **Destructive and non-destructive materials and components testing methods and their combined application in the projects on reactor safety research.** Kussmaul, K.; Hoeller, P. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

7593 (GRS—18, pp 39-47) **International 2D/3D project as a consequence of the results of emergency core cooling.** Mayinger, F. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

As a part of the trilateral co-operation between the Federal Republic of Germany, Japan and the USA large projects have been set about which are adapted to one another by contract and closely coupled as regards the test performance as well as the analysis of the results. These projects simulate on a 1:1 scale the constructive situations in the reactor and verify the fluid dynamic conditions for the heat transport. The experimental investigations are closely coupled with theoretical analyses as a part of the development of a new generation of tridimensional computer codes.

7594 (GRS—18, pp 48-63) **Results of the studies on the problems of small leaks and consequences for experiment planning.** Riebold, W.L.; Karwat, H. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

Included are: 1. Classification of loss of coolant incidents; 2. Importance of Small Leaks in the safety analysis of LWRs; 3. Analytical investigations on the problems of Small Leaks (e.g. RELAP-, DRUFAN-code); and 4. Experimental investigations on the problems of Small Leaks (PKL-KWU, LOBI-Ispra).

7595 (GRS—18, pp 64-72) **Results of the investigations of transient fuel rod behaviour.** Fiege, A. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

The aim of the research on the fuel rod behaviour mainly effected in the KFZ Karlsruhe and at the KWU Erlangen as a part of the German reactor safety research program is to investigate the physical and chemical phenomena which are significant when the zircaloy claddings are failing, and to establish mathematical models verified by experiments by means of which the extent of damage in the reactor core in different incidents can be worked out in a realistic way. These mathematical models (program system SSYST) shall replace the conservative assumptions so far used for incident analyses and quantify their safety reserves, respectively.

7596 (GRS—18, pp 73-79) **Method to determine the main phenomena of hypothetical core meltdown accidents and analysis of the results.** Wiesner, S. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

In individual experimental and theoretical working packages the heat-up and meltdown of an uncooled reactor core, the behaviour of a melt of fuel and structure material on the bottom of a reactor pressure vessel, and the interaction of a fuel-structure material-melt with the concrete of the reactor cell have been investigated. Further supporting investigations provided material values for the media participating in the reactions or they served for localizing boundary conditions. The latter include to work out the fissionable fuel transport for the quantification of the heat source density in the respective melt as well as to investigate the fuel-coolant-interaction for the quantification of the effects of steam explosions. Furthermore, also the coolant supply into the reactor core in different failures of the emergency cooling systems have been parametrically calculated in order to determine realistic initial conditions for the heat-up phase of an insufficiently cooled reactor core.

7597 (GRS—18, pp 80-91) **Findings and trends of the safety containment investigations.** Hicken, E. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

In the case of a loss of coolant incident the safety enclosure is one of the most important barriers against a release of radioactive substances. For PWRs in general full pressure safety vessels are built, while for BWRs safety enclosures with pressure suppression systems have succeeded. The different types are briefly explained.

7598 (GRS—18, pp 92-98) **Response of nuclear power plant structures under dynamic loads.** Koenig, G. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

In the field of seismic protection, the installation of a vast number of measuring points and an evaluation of extensive data compilations offer a possibility of obtaining more accurate load curves. Theoretical methods to determine ground/structure interactions have already reached a high level of accuracy. Boundary con-

ditions are validated in large-scale shaker experiments. For aircraft crashes, the emphasis is on experimental validation of non-linear calculation models and suitable limiting states. For gas explosions, load descriptions play a major part. With the knowledge thus obtained, it should be possible to predict the effects of dynamic loads.

7599 (GRS—18, pp 107-112) **Role of integral tests in real plants, illustrated by the example of the HDR reactor.** Mueller-Dietsche, W. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

After defining the requirements to integral experiments it is explained to what extent the experiments as a part of the HDR safety program meet these requirements. For this purpose the investigated components and systems as well as the considered loading conditions are presented. The aim of this program is the verification of testing- and calculation methods such as applied or developed, respectively, for the design and licensing of nuclear power plants. In this matter it is above all the loads occurring by loss of coolant incidents and earthquakes that are concerned at present.

7600 (GRS—18, pp 114-130) **Consequences of the findings of the risk study for reactor safety research.** Birkhofer, A. Dec 1980. (In German). NTIS (US Sales Only), PC A08/MF A01.

From 1. GRS-meeting on reactor safety research; Koeln, F.R. Germany (29 May 19780).

Conclusions for the reactor safety research can be drawn under two aspects which indeed influence one another: 1. Which research projects suit to contribute to a reduction of the risks, and 2. by which research can the risk assessment itself be improved. According to the essential steps of the risk analysis three fields are concerned: 1. Systems technique and incident analysis, 2. core meltdown accidents and fission product release, and 3. effects of accidents.

7601 (GRS—19(8-80), pp 697-703) **Need for criteria and philisophical development for human factors accountability in nuclear power plants.** Patterson, E.S. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The following is a commentary for the purpose of identifying specific areas where there is a serious need for criteria and philosophical development that will permit designers to move rapidly to account for human factors in nuclear power plants. While only a few specific problems are discussed, it is recognized that the need for engineering criteria exists for a much broader range of human behavioral problems.

7602 (GRS—19(8-80), pp 759-775) **Psychology of communications.** Hunns, D.M. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

A theory is proposed relating to the structuring of mental models and this theory used to account for a number of human error mechanisms. Communications amongst operators and the systems around them is seen as a vital factor in the area of human error and a technique, communications analysis, is proposed as one approach to systematically predicting the ways in which actual system state and the operators' perceptions of that state can get out of step and lead to catastrophe. To be most effective it is expected that the analyst would apply communications analyst with an interactive computer system. Of particular importance is the ability to trace the operator-system communication scenarios in various abnormal system configurations.

7603 (GRS—19(8-80), pp 779-792) **Measurements of operator performance - an experimental setup.** Netland, K. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

The human has to be considered as an important element in a process control system, even if the degree of automation is extremely high. Other elements, e.g. computer, displays, etc., can to a large extent be described and quantified. The human (operator), is difficult to describe in a precise way, and it is just as difficult to predict his thinking and acting in a control room environment. Many factors influence his performance, such as: experience, motivation, level of knowledge, training, control environment, job organization, etc. These factors have to a certain degree to be described before guidelines for design of the man-process interfaces and the control room layout can be developed. For decades, the psychological science has obtained knowledge of the human mind and behaviour. This knowledge should have the potential of a positive input on our effort to describe the factors influencing the operator performance. Even if the human is complex, a better understanding of his thinking and acting, and a more precise description of the factors influencing his performance can be obtained. At OECD Halden Reactor Project an experimental set-up for such studies has been developed and implemented in the computer laboratory. The present set-up includes elements as a computer- and display-based control room, a simulator representing a nuclear power plant, training programme for the subjects, and methods for the experiments. Set-up modules allow reconfiguration of experiments.

7604 (GRS—19(8-80), pp 795-812) **Procedures for the operator - their role and support.** Goodstein, L.P. Aug 1980. NTIS (US Sales Only), PC A99/MF A01.

From Process and systems for assisting an operator during normal and anomalous nuclear power plant operation situations meeting; Muenchen, F.R. Germany (5 Dec 1979).

In the light of the experience gained by the US NRL, it can be useful to take a fresh look at procedures by first examining the operator's work situation, his behavioral characteristics and then at his need for suitable support, for example, in the form of procedures and all of this in light of his responsibilities for monitoring and controlling a dynamic, complex and occasionally unpredictable process. An added impetus for doing this exists in the form of the process computer and the possibilities which it offers for providing support for procedures. The paper concludes with a brief description of such an application.

7605 **(GRS—21) Calculations on the experiments No. 7-9 of the RS 246 project on hydrogen distribution in the containment, carried out at Battelle Institut, Frankfurt/Main, using the RALOC computer model.** Erdmann, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1981. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750418.

Gaseous hydrogen can be produced by chemical reactions in a light water reactor after a loss of coolant accident (LOCA). By this it can be possible that a dangerous explosive gas mixture (oxyhydrogen) is developing at unfavorable locations in the containment atmosphere. It was the aim of project Wasserstoffverhalten bei Kuehlmittelverluststoerfaellen to investigate the H_2-distribution as a result of convection, diffusion and solution transient. In this report numerical calculations with the computer model RALOC are presented which was developed by Jahn/6/. The calculations are compared with experimental data Nr. 7-9 performed during the project RS 246 by Battelle-Institute, Frankfurt. It is shown that the numerical model RALOC gives a good representation of the temporal and local distribution of hydrogen concentration within the containment.

7606 **(GRS—22) Implementation of SSYST-1 on the GRS computer and first verification calculations.** Schubert, J.D.; Ullrich, R. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1981. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750342.

The program system SSYST-1, being developed in Karlsruhe, has been implemented on the AMDAHL-computer together with special modulus for the items eccentric stress and probabilistic analysis. First computations for the REBEKA-3 experiment and other test examples, done to verify the new implementation, showed satisfactory results, especially a good correspondence with measurements for the instant of bursting, the bursting temperature

and the difference in temperature on the periphere. Initial difficulties arised from using the model for circumvariable stress and temperature analyses. The reason was, that this modulus is meant for the program SSYST-2, thus its use in SSYST-1 led to interface problems which, however, are resolved now.

7607 **(GRS—28) Backfitting of research reactors. Pt. 1.** Leven, D.; Wendling, R.D.; Wurtinger, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Oct 1981. 19p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750419.

It is the aim of this paper to fixe the basis for constituting safety requirements in research reactors as well as to list priorities allowing the analysis of research reactors with respect to maybe necessary backfitting measures. Therefore, the research reactors have been attached to different system groups and risk groups. The criteria leading to this classification are based on the evaluation of the requirements to the systems for controlling the after-heat removal, and on the evaluation of the hazards potential of the reactors. It could be showed that all research reactors in the German Federal Republic can be classified into three system groups and three risk groups. The results of the classification into these groups have been put into relation; this leads to a sequence of the stages for the necessary safety requirements as well as to a listing of priorities allowing the analysis of research reactors with respect to maybe necessary backfitting measures. The group with highest requirements and highest priority includes 10% of the investigated research reactors; the group with next lower requirements and second priority includes 23%. 67% are to be classified in the group with lowest requirements and third priority.

7608 **(GRS—44) Program system RALLY - for probabilistic safety analysis of large technical systems.** Gueldner, W.; Polke, H.; Spindler, H.; Zipf, G. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Mar 1982. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82751056.

This report describes the program system RALLY to compute the reliability of large and intermeshed technical systems. In addition to a short explanation of the different programs, the possible applications of the program system RALLY are demonstrated. Finally, the most important studies carried out so far on RALLY are discussed.

7609 **(GRS—F-111) List of reports from the BMFT, CEA, EPRI, JSTA and USNRC concerning reactor safety research.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1981. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750420.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning special Problems in the field of Reactor Safety Research. According to the cooperation of the Bundesminister fuer Forschung und Technologie (BMFT) with the Commissariat a l'Energie Atomique (CEA) the Japan Science and Technology Agency (JSTA) the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Program of the BMFT, reporting organization. The list of reports appears quarterly.

7610 **(GRS-F—110) Reports on research projects in the field of reactor safety receiving financial aid by the Federal Minister for Research and Technology. Period covered: 1 April - 30 June 1981.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1981. 398p. (In German). NTIS (US Sales Only), PC A17/MF A01. Order Number DE82750343.

The individual reports are arranged according to the Research Program on the Safety of LWRs 1977-1980 of the BMFT. Another table of contents uses the same classification system as applied in the Nuclear Safety Index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The reports are marked by current numbers in sequence of their arrangement in this compilation.

7611 **(GRS-F—112) List of reports from BMFT, CEA, EPRI, JSTA and USNRC concerning reactor safety research.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Feb 1982. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750735.

This list reviews reports from the Federal Republic of Germany, from France from Japan and from the United States of America concerning special problems in the field of reactor safety research. According to the cooperation in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programm of the BMFT, reporting organization. The list of reports appears quarterly.

7612 **(GRS-F—114) Reports on research projects in the field of reactor safety sponsored by BMFT (Federal Ministry for Science and Technology).** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Mar 1982. 503p. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE82750966.

The GRS (Reactor Safety Association), Gesellschaft fuer Reaktorsicherheit mbH, by order of the BMFT, informs continuously of the status of such investigations by means of semi-annual and annual publication of progress reports within the series GRS-F-Fortschrittsberichte (GRS-F-Progress Reports). Each progress report represents a compilation of individual reports about objectives, the work performed, the results, the next steps of the work etc. The individual reports are prepared in a standard form by the contractors themselves as a documentation of their progress in work and published by the FB (Research Coordination Department), Forschungsbetreuung at the GRS, within the framework of general information of progress in reactor safety research. The individual reports are classified according to the Research Program on the Safety of LWRs 1977-1980 of the BMFT. Another table of contents uses the same classification system as applied in the Nuclear Safety Index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The reports are arranged in the sequence of their project numbers.

7613 **(GRS-F—116) List of reactor safety reports published by BMFT, CEA, EPRI, JSTA and USNRC.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1982. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750969.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning special problems in the field of reactor safety research. The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Program of the BMFT, reporting organization. The list of reports appears quarterly.

7614 **(IKE—4-102) Theoretical investigations on fuel rod behavior during the TMI-2 incident and similar calculations for a German PWR of type Biblis.** Tuerk, W.; Schmidt, F.; Bisanz, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). May 1981. 96p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750341.

Calculations for the dry out phase of the TMI-2 incident (114 min to 174 min) were performed with the program TMIBOIL and the program systems SSYST, EXMEL and MELSIM2. Similar calculations were performed for a German reactor of type Biblis using the same set of thermohydraulic boundary conditions. TMIBOIL predicts a completely destroyed core EXMEL and MELSIM2 predict for both reactors the beginning of the melting process. However the reactors remain coolable.

7615 **(Juel-Spez—135) PLATO - a program for the calculation of plateout.** Ehrhardt, K.D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Dec 1981. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750659.

The program for the calculation of the plateout in a steam generator of a HTR in case of heat-up-accident is presented. The report contains both the description of the model as well as its realization.

7616 **(Juel-Spez—136(Bd.5)) Safety study for HTR-concepts under German siting conditions.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung; Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Dec 1981. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750963.

The report presents the investigations which were carried out in the study to answer the question of the significance of external impacts (such as earthquakes in the first instance, but also storms, floods, crash of an aircraft, shock waves, turbine explosions, failures of feedwater tanks) for the risk posed by the HTR conceptual design analyzed. Schmehausen served as the assumed site. External impacts can initiate incidents which result in a core heat-up and their course can be compared with those initiated by transients (e.g. failure of emergency power). However, due to the slight occurrence frequency of external impacts and the protective precautions taken, their frequency is much lower than that of initiating events within the plant, so that they do not provide any sizable contributions to the risk. The investigations are in part associated with considerable uncertainties which can be decreased by further research projects, which are largely already in progress.

7617 **(KFK—2890) WECHSL Code: A computer program for the interaction of a core melt with concrete.** Reimann, M.; Murfin, W.B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Nov 1981. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750421.

The WECHSL Code is a mechanistic computer code developed for the analysis of the interaction of molten LWR reactor materials with concrete. The code in its present state performs calculations from the time of the initial contact of a hot molten pool slumping into a concrete cavity to the time of freezing of an entire layer of the pool. The modelling of the freezing phase, however, needs some further elaboration along with experimental confirmation. The code is capable to treat both the limited type of simulation experiments with melt masses between 100 and 600 kg as well as hypothetical core melt down accidents with actual, full scale reactor dimensions. The submodels used in the code and their physical background are described in detail. Furthermore, the results of a test sample along with instructions for the use of the code are given.

7618 **(KFK—3150) Project Nuclear Safety.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Nov 1981. 143p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750422.

The semiannual progress report 1981/1 is a description of work within the Nuclear Safety Project performed in the first six month of 1981 in the nuclear safety field by KfK institutes and departments and by external institutions on behalf of KfK. The chosen kind of this report is that of short summaries, containing the topics, work performed, results obtained, plans for future work. This report was compiled by the project management.

7619 **(KFK—3234) Human factor in operating nuclear power plants during crisis situations.** Schnauder, H.; Smidt, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Oct 1981. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750423.

Human factors in nuclear power plant operation are a main part of safety analyses. A considerable reduction in the influence of human factors has been obtained through ergonomic control room design, automation, clearly formulated operating manuals, and appropriate personnel education and training. These precautions are directed primarily at skill- and rule-based behaviour and are intended for normal operation and design accidents. In addition, one can construct an area of uncommon and very rare events where a partial failure of the safety systems is assumed. This is an area of knowledge-based behaviour. This report describes and assesses the present situation in German nuclear power plants. Recommendations for further research activity are made and, as a main result, for improvements in knowledge-based behaviour.

7620 **(KFK—3267) Analysis of the vertical penetration of a heated fluid layer in a solid, miscible bed.** Eck, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Mar 1982. 186p. (In German). B. Order Number DE82750945.

Thesis.

The present study investigates the mass and heat transfer for the vertical penetration of a heated fluid layer in a solid, miscible bed using water-salt solutions ($ZnBr_2$, NaBr) and polyethylenglycol 1500 (PEG) as simulation materials. The time depending spatial distribution of the molten material (PEG) has been measured for the first time with conductivity probes. The dependence of the downward heat flux on the density ratio rho*, i.e. the density of the fluid / the density of the molten solid, has been investigated with two different methods of heating, planar heating with a heat exchanger in a defined initial distance to the PEG-surface and electrolytical volume heating with a defined and timely constant power input. For $1 < rho^* < 1.2$ and $ZnBr_2$ two layers have been observed in the fluid. This phenomenon is caused among other things by an anomality of the mixture density of the system salt solution-PEG. This process affects the downward heat flux so strongly, that it is impossible to transfer the results of such a system in this region of rho* to another system, for example to a corecatcher. The discrepancies between the measured heat fluxes and heat transfer coefficients of this study and that of other authors can be explained by the different construction of the planar heater, or by different boundary conditions in the case of volume heating.

7621 **(KFK—3270) Collection of papers presented at the annual colloquium 1981 of the Nuclear Safety Project, Karlsruhe, November 17, 1981.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Feb 1982. 273p. (In German, English). (CONF-811143—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE82750693.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

The report comprises the eight papers presented on the topic 'Safety research of LWR nuclear power plants'.

7622 (KFK—3270, pp 1-16) **Importance of international cooperation in the field of reactor safety research.** Seipel, H. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

Based on an overview of present planning performed in reactor safety research in the Federal Republic of Germany within the framework of updating the energy research program it is shown that international consensus has been established to a large extent concerning the necessary new initiatives and shifts in central activities. The reorientation received its impetus above all from risk studies but also from knowledge derived from the Harrisburg accident. Emphasis should be placed in particular on the efforts taken to acquire a realistic understanding not only of large loss-of-coolant-accidents but especially also of malfunctions of the system due to minor leakages and transients associated with the additional failure of components and auxiliary systems. A better assessment of hypothetic accidents, on the one hand, calls for more detailed studies of the actual sequence of failures susceptible of degrading or melt-

ing the reactor core and, on the other hand, of the essential phenomena getting effective in the release, retention and atmospheric distribution of fission products. Besides, research activities are important which contribute to the early detection of defects and malfunctions in nuclear power stations and assist the operators in diagnosis and decision making so as the enable them to take effective countermeasures. The mechanisms of cooperation existing in reactor safety research within the framework of the EC, OECD and IAEA are described. Bilateral cooperation above all with the USA, Japan and France, continues to be of particular importance. In the context of cooperation with threshold countries and based on experience accumulated in the Federal Republic of Germany, the importance is underlined here of early reactor safety research performed in these countries on their own.

7623 (KFK—3270, pp 17-76) **Recent advances of reactor safety research in the nuclear safety project.** Rininsland, H.; Fiege, A.; Gulden, W.; Horsch, F.; Hosemann, J.P. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

The investigations of the PNS concerning the 2F-LOCA are nearly completed. The fuel rod behavior can now be described quantitatively. The experimental and analytical work on structure dynamics for reactor components shows an essential decrease of the load under blowdown in consideration of the fluid-structure interaction. In general the investigations on reactor safety are now changing to hypothetical accidents with severe core damage and core melt down. First results on oxidation behavior of Zircaloy tubes at temperatures above 1200°C and on the interaction between Zircaloy and fuel with formation of liquified phases are reported. In case of a core meltdown accident a complete list of release data for the essential radionuclides is available. In consideration of new results on the behavior of airborne particle masses best estimate calculations show the extreme conservatism of the assumptions made in the existing risk studies. The code models essential for the determination of accident consequences and able to describe the atmospheric distribution have been improved.

7624 (KFK—3270, pp 77-107) **Thermohydraulics in emergency core cooling - conservative or best estimate analysis.** Mayinger, F. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

In licencing up to now the emergency core cooling analysis and by this the maximum temperatures of the fuel rods and possible cladding damages are calculated with conservative assumptions for the input parameters in the thermohydraulic analysis. The status of knowledge in this field, however, was improved remarkably by experiments and also by theoretical deliberations, so that best-estimate calculations would be possible. The differences between conservative and best estimate calculations are demonstrated.

7625 (KFK—3270, pp 109-139) **Recent developments in consequence modeling.** Aldrich, D.C.; Alpert, D.J.; Sprung, J.L.; Blond, R.M. Feb 1982. NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

A number of important developments have occurred recently in the area of nuclear reactor accident consequence analysis, including improvements in modeling capabilities, model evaluation studies, and application of existing models to provide useful guidance for planning and decision making. A brief background to the consequence modeling field is provided, and these recent developments are reviewed. Limitations in current modeling capabilities are discussed and important areas for future research are recommended.

7626 (KFK—3270, pp 141-191) **Additional investigations on the consequences of accidents.** Ehrhardt, J.; Bayer, A.; Burkart, K. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

As a first step to improve the accident consequence model of the German Risk Study within the Phase B, additional investigations on special problems and questions were performed. Detailed attention is given to the following topics: emergency protective actions in the vicinity of the site; latent cancer fatalities - allocated to the population living during the nuclear accident and to persons born afterwards, within and beyond a distance of 540 km from the site, caused by radiation doses below the dose limits of the German radiation protection regulations estimated assuming a nonlinear dose response function; risk assessments of nuclear power plants with lower capacities; loss of life expectancy after accidental radiation exposure. All results are presented separately for the 8 release categories of the German Risk Study.

7627 (KFK—3270, pp 193-216) **Chemical reactions of iodine during severe reactor accidents.** Ache, H.J.; Neeb, K.H. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

Fission-iodine reacts with water to form iodine in serveral chemical states. These iodine species are overwhelmingly not or only slightly volatile and are retained in the aqueous phase under the experimental conditions which prevail during reactor accidents. This is consistent with the observations made in the case of accidents which have occured with water-cooled reactors, such as TMI-2, where the small amount of fission iodine released to the environment can be explained only by the nature of the chemical reactions of the fission-iodine. In this paper the chemical equilibria involved in the reactions of iodine with water will be discussed and the effect of several parameters on the equilibria and thus on the amount of volatile iodine species present evaluated. By using a flow scheme the results of these chemical reactions on the distribution of iodine in the various areas of the reactor building following a reactor accident will be considered. Finally several topics will be listed where further research and development is needed for a quantitative assessment of these effects. The overall objective of this research is the incorporation of the fission iodine retention caused by chemical interaction into reactor accident model calculations leading to a realistic evaluation of iodine release following severe reactor accidents.

7628 (KFK—3270, pp 217-236) **LWR fuel cladding deformation in a LOCA and its interaction with the emergency core cooling.** Erbacher, F.J. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

The paper summarizes research results of out-of-pile burst tests, in-pile bursts tests, out-of-pile flooding tests and modeling work on fuel behavior in a LOCA performed at KfK: The dominant phenomena of the cladding deformation and failure have been clarified by experiments and can be modeled by computer codes. The burst and flooding tests performed up to now suggest that the coolability of the core under LOCA conditions can be maintained.

7629 (KFK—3270, pp 237-260) **Evaluation of fuel rod damage in LWR under accident conditions using SSYST.** Meyder, R. Feb 1982. (In German). NTIS (US Sales Only), PC A12/MF A01.

From 8. annual colloquium of the Nuclear Safety Project; Karlsruhe, F.R. Germany (16 Nov 1981).

After a short outline of the recent SSYST-development, the creep rupture model NORA 2 is presented. The effect of temperature and oxygen on Zircaloy 4 creep behaviour is shown. Examples on the effect of azimuthal varying gap width and wall thickness are given. Remarks on the extension of a single rod analysis on a bundle and the stepwise application of SSYST for investigation of fuel rod failure conclude the paper.

7630 (KFK—3276) Vapor pressures of oxide reactor fuels above 3000 K: Review and perspective. Breitung, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Mar 1982. 126p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750739.

Vapor pressures of liquid oxide reactor fuels are among the most important material data required for theoretical analyses of Hypothetical Core Disruptive Accidents in Fast Breeder Reactors. This report is an attempt to completely summarize and critically review the numerous theoretical and experimental results published for the pressure-temperature and pressure-energy relation of unirradiated UO_2 and $(U,Pu)O_2$. First - to define the research goal - the precision in the saturation vapor pressure is quantified which is required for the purpose of HCDA calculations. Then the various theoretical and experimental methods used for the determination of p-T and p-U data are reviewed with respect to their principles, results and uncertainties. The achievements of the individual methods are discussed in the light of the research goal and - in view of the widely scattered data - recommendations are made concerning the p-T and p-U relation of UO_2. Finally, the most important future research areas are identified, including some specific research proposals which aim at reducing the still large uncertainties in fuel vapor pressures down to the desired level.

7631 (KFK—3288) In-pile experiments on the fuel rod behavior in a loss-of-coolant accident. Hofmann, P.; Petersen, C.; Schanz, G.; Zimmermann, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Mar 1982. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750692.

This report describes the results of the destructive postirradiation examination of Test Series F with respect to the mechanical behavior of Zircaloy-4 cladding material, the oxidation and corrosion behavior of the cladding, the mechanical behavior of the fuel, and the fission gas release and volume change of the fuel. No difference between the behavior of unirradiated and preirradiated rods has been found, with the exception of the fuel condition. In the preirradiated fuel rods the fuel underwent considerable fragmentation during the experiments. Oxidation of the inside surface of the cladding was observed at and near the rupture and was caused primarily by penetrating steam. The fuel contributes slightly to oxidation of the cladding inside surface. No influence of iodine or other volatile fission products on the deformation and fracture behavior due to stress corrosion cracking has been found. The maximum fission gas release during preirradiation was 5.5% with an additional 6% release during the in-pile LOCA transient.

7632 (KFK—3293) Report on research and development work 1981 of the Institut fuer Reaktorentwicklung. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Feb 1982. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750742.

The Institute for Reactor Development works chiefly on technical problems as a function of the development and safety evidence of nuclear installations. The tasks that are for a greater part performed together with other internal and external institutions, are both theoretical- and experimental-natured and concentrate mainly on problems out of the reactor safety. The works are in the main concentrated in the 'Fast Breeder Project' (PSB) and in the 'Nuclear Safety Project' (PNS). The PSB-contributions to design and safety of sodium-cooled breeding reactors comprise above all investigations on the thermohydraulic and neutronkinetic behaviour of the core as a result of incidents with very low probability to occur, as well as on the effects of local cooling failures in the reactor core in particular consideration of possible failure propagation mechanisms and of the detectability of such processes. The works in the field of safety of lightwater reactors concern in particular investigations on the dynamic load of component parts of reactor pressure vessels related with the HDR-blowdown-tests and containment structures, as well as investigations on the fuel rod behaviour in the loss of coolant incident.

7633 (KFK—3319) PSTAT: A computer code for the mechanical interaction between fuel and cladding in fast breeder fuel pins. Steiner, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1982. 59p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82751055.

The mechanical interaction between fuel pellets and cladding is a phenomenon of greatest importance for the irradiation behaviour of fast reactor fuel pins. On behalf of the load and strain of the clad which lead to clad dammage this one may cause problems for the clad integrity. Thus, to have an effective tool for the calculation of the mechanical interaction and related topics, the computer code PSTAT was developed. In this code fuel mechanics is treated in the frame of a three-zone-model for a definite cross section. The heat conduction equation is solved by means of an implicit three-point finite difference technique. On account of a mostly simple and a summary modeling of different irradiation phenomena a fast running code of restricted extent resulted. In view of the rather complicated histories of many test irradiations which have to be evaluated, this fact represents a great advantage for the user. This report contains a representation of the theoretical basis of the used models, a description of the code with instructions for its utilization and a discussion of various test calculations for oxide and carbide fuel pins. Especially the code results for the irradiation experiments Mol-11/K2-3 and Mol-10 support the conclusion that the code PSTAT yields a correct description of the conditions under irradiation.

7634 (KFK—3320) Analysis of model cases of secondary recriticalities in the core region of SNR-300 (Mark 1A core). Maschek, W.; Froehlich, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Apr 1982. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750975.

In the framework of the licensing process for SNR-300 recriticalities and secondary excursions have been analyzed for severe hypothetical loss of flow accidents. The energetics of secondary excursions, which can be triggered by different conceivable forms of recriticality as the collapse of boiling fuel/steel pools or the reentry of previously ejected core material into high material worth regions, have been estimated and upper bounds are given on the basis of various model cases. The results of this bounding case study show that the maximum mechanical energy releases (determined by expansion of the hot fuel vapor to the stretched cover gas volume of SNR-300) yield with superposition of numerous pessimistic assumptions concerning modelling and parameters about 100 MJ.

7635 (KFK—3358) Oxidation of Zircaloy 4 tubing in steam at 1350 to 1600°C. Aly, A.E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). May 1982. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82751053.

The oxidation behaviour of Zircaloy 4 (KWU-type) tubing in steam was investigated under Light Water Reactors (LWR) severe core damage conditions. Reactions kinetics were measured over the temperature range 1350-1600°C. The reaction kinetics were described by a parabolic rate of mass increase and ZrO_2 scale growth. The ZrO_2 scale preserved its protective nature up to the complete metal consumption. A discontinuity was found in the temperature dependence of the reaction rates of mass increase which is attributed to the change in the oxide microstructure at the discontinuity temperature (1550°C). The results also indicated the severe degree of embrittlement induced by oxidation. The dependence of microhardness on dissolved oxygen concentration in the underlying metal has been established.

7636 **(KFK—3359) SSYST, a code-system for analysing transient LWR fuel rod behaviour under off-normal conditions.** Borgwaldt, H.; Gulden, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Jun 1982. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82751054.

SSYST is a code-system for analysing transient fuel rod behaviour under off-normal conditions, developed conjointly by the Institut fuer Kernenergetik und Energiesysteme (IKE), Stuttgart, and Kernforschungszentrum Karlsruhe (KfK) under contract of Projekt Nukleare Sicherheit (PNS) at KfK. Main differences versus codes with similar applications are: (1) an open-ended modular code organisation, and (2) a preference for simple models, wherever possible. While the first feature makes SSYST a very flexible tool, easily adapted to changing requirements, the second feature leads to short execution times. The analysis of transient rod behaviour under LOCA boundary conditions takes 2 mins cpu-time (IBM-3033), so that extensive parametric studies become possible. The paper gives an outline of the overall code organisation and a general overview of the physical models implemented. Besides explaining the routine application of SSYST in the analysis of LOCA, examples are given of special applications, which have led to a satisfactory understanding of the decisive influence of deviations from rotational symmetry on the fuel rod perimeter.

7637 **(LA-UR—82-1664) Numerically induced pressure excursions in two-phase-flow calculations. Final report.** Mahaffy, J.H.; Liles, D.R. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-830103—22). NTIS, PC A02/MF A01. Order Number DE83000351.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

Pressure spikes that cannot be traced to any physical origin sometimes are observed when standard Eulerian finite-difference methods are used to calculate two-phase-flow transients. This problem occurs with varying frequency in nuclear reactor safety codes such as RELAP, RETRAN, COBRA, and TRAC. These spikes usually result from numerical water packing or from interactions between spatial discretization and heat transfer.

7638 **(LA-UR—82-1665) Post-test analysis of semiscale tests S-UT-6 and S-UT-7 using TRAC PF1.** Boyack, B.E. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 28p. (CONF-830103—7). NTIS, PC A03/MF A01. Order Number DE82018382.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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A posttest study of Semiscale Tests S-UT-6 and S-UT-7 has been completed to assess TRAC-PF1 predictions of pressurized water-reactor (PWR) small-break transients. The comparisons of the TRAC calculations and experimental results show that the correct qualitative influence of upper-head injection (UHI) was predicted. The major phenomenological difference predicted was the mode of core voiding. The data show a slow boiloff from the top of the core resulting in a dryout near the top of the core only. TRAC predicted a more extensive voiding with fluid forced from the bottom of the core by a pressure increase in the upper vessel plenum. The pressure increase was the primary consequence of a failure to predict a complete clearance of the seal in the intact-loop pump-suction upflow leg. Further review of the interphasic drag correlations, entrainment correlations, and critical-flow model is recommended. 20 figures.

7639 **(LA-UR—82-1666) TRAC-PF1 choked-flow model.** Sahota, M.S.; Lime, J.F. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 17p. (CONF-830103—8). NTIS, PC A02/MF A01. Order Number DE82018383.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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The two-phase, two-component choked-flow model implemented in the latest version of the Transient Reactor analysis Code (TRAC-PF1) was developed from first principles using the characteristic analysis approach. The subcooled choked-flow model in TRAC-PF1 is a modified form of the Burnell model. This paper discusses these choked-flow models and their implementation in TRAC-PF1. comparisons using the TRAC-PF1 choked-flow models are made with the Burnell model for subcooled flow and with the homogeneous-equilibrium model (HEM) for two-phae flow. These comparisons agree well under homogeneous conditions. Generally good agreements have been obtained between the TRAC-PF1 results from models using the choking criteria and those using a fine mesh (natural choking). Code-data comparisons between the separate-effects tests of the Marviken facility and the Edwards' blowdown experiment also are favorable. 10 figures.

7640 **(LA-UR—82-1715) Fuel penetration of intersubassembly gaps in LMFBRs: a calculational method with the SIMMER-II code.** DeVault, G.P. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 29p. (CONF-830103—13). NTIS, PC A03/MF A01. Order Number DE82018453.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

Early fuel removal from the active core of a liquid-metal-cooled fast breeder reactor (LMFBR) undergoing a core-disruptive accident may reduce the potential for large energetics resulting from recriticalities. A possible avenue for early fuel removal in heterogeneous core LMFBRs is the failure of duct walls in disrupted driver subassemblies followed by fuel penetration into the gaps between blanket subassemblies. The SIMMER-II code was modified to simulate flow between subassembly gaps. Calculations with the modified SIMMER-II code indicate the capabilities of the method and the potential for fuel mass reduction in the active core.

7641 **(LA-UR—82-1716) Unmitigated boron dilution events in a PWR.** Henninger, R.J.; Woodruff, S.B. (Los Alamos National Lab., NM (USA)). Mar 1982. Contract W-7405-ENG-36. 31p. (CONF-830103—11). NTIS, PC A03/MF A01. Order Number DE82018455.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

Dissolved boron is required for control of reactivity in a pressurized water reactor that is shut down. TRAC-PF1 calculations for a typical PWR for vessel-closed and vessel-open configurations show that a high-power excursion (approaching 20% of nominal operating power) is possible if dilution of the boron solution occurs. The calculations also show that sufficient heat capacity exists in the primary system to prevent a large temperature increase and that natural circulation flow of high concentration boron solution from the primary system into the core region will terminate the excursion.

7642 **(LA-UR—82-1717) Effects of the reactor-coolant pumps during a small-break loss-of-coolant accident.** Elliott, J.L. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 37p. (CONF-830103—10). NTIS, PC A03/MF A01. Order Number DE82018456.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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TRAC-PD2 calculations indicate that more coolant mass remains in the system when the reactor coolant pumps are left in operation following a small cold-leg break. The analyses were performed for a Westinghouse plant (Zion-1) to help determine whether to trip the pumps at high-pressure injection initiation (the present operator directive), to trip the pumps at some later time in the transient, or to leave the pumps running indefinitely. The loop seals' behavior and the system refill characteristics primarily determined the results. 9 figures.

7643 **(LA-UR—82-1718) Thermal-hydraulic analyses of pressurized-thermal-shock-induced vessel ruptures.** Dobranich, D. (Los Alamos National Lab., NM (USA)). May 1982. Contract W-7405-ENG-36. 20p. (CONF-830103—9). NTIS, PC A02/MF A01. Order Number DE82018450.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

A severe overcooling transient was postulated to produce vessel wall temperatures below the nil-ductility transition temperature which in conjunction with system repressurization, led to vessel rupture at the core midplane. Such transients are referred to as pressurized-thermal-shock transients. A wide range of vessel rupture sizes were investigated to assess the emergency system's ability to cool the fuel rods. Ruptures greater than approximately 0.015 m^2 produced flows greater than those of the emergency system and resulted in core uncovery and subsequent core damage.

7644 **(LA-UR—82-1759) Containment condensing heat transfer.** Gido, R.G.; Koestel, A. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 25p. (CONF-830103—12). NTIS, PC A02/MF A01. Order Number DE82018448.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

This report presents a mechanistic heat-transfer model that is valid for large scale containment heat sinks. The model development is based on the determination that the condensation is controlled by mass diffusion through the vapor-air boundary layer, and the application of the classic Reynolds' analogy to formulate expressions for the transfer of heat and mass based on hydrodynamic measurements of the momentum transfer. As a result, the analysis depends on the quantification of the shear stress (momentum transfer) at the interface between the condensate film and the vapor-air boundary layer. In addition, the currently used Tagami and Uchida test observations and their range of applicability are explained.

7645 **(LA-UR—82-1768) TRAC analysis of radial-power-distribution effects on forced-feed reflood experiments.** Fujita, R.K. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 19p. (CONF-830103—6). NTIS, PC A02/MF A01. Order Number DE82018431.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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TRAC thermal-hydraulic computer program predictions were compared with transient forced-feed reflood experiments. Three forced-flooding, large-scale reflood tests were analyzed to investigate the effect of the radial power distribution on the reflooding behavior of an electrically heated core. TRAC predicted the trends of the data quite well, including the multidimensional hydraulic effects observed in the tests. The variations in the radial power profile do not significantly affect the overall quenching of the core. 10 figures.

7646 **(LA-UR—82-1769) Investigation of radial power and temperature effects in large-scale reflood experiments.** Motley, F. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 23p. (CONF-830103—15). NTIS, PC A02/MF A01. Order Number DE82016281.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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The largest reflood test facility in the world has been designed and constructed by the Japan Atomic Energy Research Institute (JAERI). The experimental test facility, known as the Cylindrical Core Test Facility (CCTF), models a full-height core section and the four primary loops of a Pressurized Water Reactor (PWR). The radial power distribution and temperature distribution were varied during the testing program. The test results indicate that the radial effects, while noticeable, do not appreciably alter the overall quenching behavior of the facility. The Transient Reactor Analysis Code (TRAC) correctly predicted the experimental results of several of the tests. The code results indicate that the core flow pattern adjusts multidimensionally to mitigate the effects of increased power or stored energy.

7647 **(LA-UR—82-1786) TRAC analysis of steam-generator overfill transients for TMI-1.** Bassett, B. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 30p. (CONF-830103—14). NTIS, PC A03/MF A01. Order Number DE82017333.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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A reactor safety issue concerning the overfilling of once-through steam generators leading to combined primary/secondary blowdown has been raised recently. A series of six calculations, performed with the LWR best-estimate code, TRAC-PD2, on a Babcock and Wilcox Plant (TMI-1), was performed to investigate this safety issue. The base calculation assumed runaway main feedwater to one steam generator causing it to overfill and to break the main steam line. Four additional calculations build onto the base case with combinations of a pump-seal failure, a steam-generator tube rupture, and the pilot-operated relief valve not reseating. A sixth calculation involved only the rupture of a single steam-generator tube. The results of these analyses indicate that for the transients investigated, the emergency cooling system provided an adequate make-up coolant flow to mitigate the accidents.

7648 **(LA-UR—82-1787) Comparison of TRAC-PD2 calculations to emergency-core-coolant bypass data.** Meier, J.K. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 14p. (CONF-830103—3). NTIS, PC A02/MF A01. Order Number DE82017332.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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The Los Alamos Transient Reactor Analysis Code, TRAC-PD2, is a multidimensional thermal-hydraulic computer code that can simulate loss-of-coolant accidents (LOCAs) in pressurized-water reactors (PWRs). As part of our independent assessment of this code, we compared TRAC calculated results with Battelle Columbus Laboratories (BCL) test data. We based our comparisons on the BCL downcomer countercurrent flow test that used a 2/15-scale model of a coreless PWR vessel. In general, TRAC tended to underpredict the steam flow necessary to prevent significant flooding of the downcomer. This underprediction is insignificant in low-subcooling cases; however, in high-subcooling cases, the steam flows for similar degrees of water penetration were 30 to 35% less in the TRAC predictions than in the test data. Thus, we infer that the calculations for the momentum transfer between the two phases were adequate, but that the interfacial heat-transfer correlations could use improvement. 14 figures.

7649 **(LA-UR—82-1800) Failure modes of a concrete nuclear-containment building subjected to hydrogen detonation.** Fugelso, L.E.; Butler, T.A. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 24p. (CONF-830103—2). NTIS, PC A02/MF A01. Order Number DE82017329.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

Calculated response for the Indian Point reactor containment building to static internal pressure and one case of a dynamic pressure representing hydrogen combustion and detonation are presented. Comparison of the potential failure modes is made. 9 figures.

7650 **(LA-UR—82-1820) Thermal-hydraulic analysis of main-steam-line-break accidents as potential initiators for reactor vessel.** Lamkin, D.E. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 38p. (CONF-830103—4). NTIS, PC A03/MF A01. Order Number DE82018387.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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Results are presented from two thermal-hydraulic analyses of postulated main-steam-line breaks for the OCONEE nuclear power plant. One calculation assumes runaway feedwater supply, whereas normal feedwater management is used in the other. The analyses were performed with the TRAC-PD2 code. The objective was to provide primary coolant temperature and pressure histories to assist in evaluating possible reactor-vessel pressurized-thermal-shock concerns. 22 figures.

7651 (LA-UR—82-1821) TRAC-PD2 modeling of a cold-leg 0.002-M² break in Babcock & Wilcox, Combustion Engineering, and Westinghouse pressurized water reactors. Lime, J.F.; Willcutt, G.J.E. Jr. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 24p. (CONF-830103—5). NTIS, PC A02/MF A01. Order Number DE82018388.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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TRAC-PD2 modeling of a cold-leg small break is presented for Babcock & Wilcox (B & W), Combustion Engineering (CE), and Westinghouse (W) pressurized water reactors. Similar break size and safety-systems availability were assumed for all three plants. These calculations are presented and compared to show the differences in plant transient response for similar break and safeguard assumptions. Plant modeling assumptions are discussed and calculational results are compared, such as system depressurization, loop voiding, core cooling, and break and safety-injection flow. The comparison shows that the CE and W transients were similar, but that the B & W transient differed from the other two transients, primarily because of vessel vent valves in the B & W plant design. For all three plants, core cooling was adequate even with availability of only half the safety-injection and auxiliary-feedwater systems. 16 figures.

7652 (LA-UR—82-1928) Thermal-radiation heat-transfer model for degraded cores. Tomkins, J.L. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 14p. (CONF-830103—18). NTIS, PC A02/MF A01. Order Number DE82019572.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

One consequence of the accident at the Three Mile Island Unit 2 (TMI-2) nuclear power plant is a realization by the nuclear power technical community that there is a need for calculational tools that can be used to analyze the TMI-2 accident and to investigate hypothetical situations involving degraded light-water reactor (LWR) cores. As a result, there are now several ongoing modeling and code development efforts in the United States among which is the development of the MIMAS (Multifield Integrated Meltdown Analysis System code) at the Los Alamos National Laboratory. This paper describes a thermal-radiation heat-transfer model for LWR degraded cores that has been developed for the MIMAS code.

7653 (NUREG—0899) Guidelines for the preparation of emergency operating procedures. Resolution of comments on NUREG-0799. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1982. 48p. NTIS, PC A03/MF A01 - GPO $5.00. Order Number DE82905462.

The purpose of this document is to identify the elements necessary for utilities to prepare and implement a program of Emergency Operating Procedures (EOPs) for use by control room personnel to assist in mitigating the consequences of a broad range of accidents and multiple equipment failures. This document applies only to the EOPs so designated; it does not address emergency preparedness or emergency planning. It also represents the resolution of comments on NUREG-0799, Draft Criteria for Preparation of Emergency Operating Procedures.

7654 (NUREG/CR—2807) Temperature estimates from zircaloy oxidation kinetics and microstructures. Olsen, C.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Oct 1982. Contract AC07-76ID01570. 49p. (EGG—2207). NTIS, PC A03/MF A01 - GPO. Order Number DE83002626.

This report reviews state-of-the-art capability to determine peak zircaloy fuel rod cladding temperatures following an abnormal temperature excursion in a nuclear reactor, based on postirradiation metallographic analysis of zircaloy microstructural and oxidation characteristics. Results of a comprehensive literature search are presented to evaluate the suitability of available zircaloy microstructural and oxidation data for estimating anticipated reactor fuel rod cladding temperatures. Additional oxidation experiments were conducted to evaluate low-temperature zircaloy oxidation characteristics for postirradiation estimation of cladding temperature by metallographic examination. Results of these experiments were used to calculate peak cladding temperatures of electrical heater rods and nuclear fuel rods that had been subjected to reactor temperature transients. Comparison of the calculated and measured peak cladding temperatures for these rods indicates that oxidation kinetics is a viable technique for estimating peak cladding temperatures over a broad temperature range. However, further improvement in zircaloy microstructure technology is necessary for precise estimation of peak cladding temperatures by microstructural examination.

7655 (NUREG/CR—2932/2) Equipment qualification research test of electrical cable with factory splices and insulation rework Test No. 2, Report No. 2. Minor, E.E.; Furgal, D.T. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1982. Contract AC04-76DP00789. 73p. (SAND—81-2027/2). NTIS, PC A04/MF A01 - GPO. Order Number DE83002820.

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Electric cables with fire-retardant chemically crosslinked polyolefin extruded insulation containing factory-made center-conductor splices and insulation repairs manufactured by General Electric Company were used in a methodology test of the IEEE Standard 383-1974. This standard is concerned with the ability of cables to function during and following exposure to aging and LOCA/MSLB environments. Cable specimens were radiation aged at a low-dose rate and then thermally aged to simulate a 40-year containment exposure. After aging, the specimens were subjected to LOCA radiation and a 33-day steam and chemical spray exposure. The cables were electrically loaded and functioned without failure during and after LOCA steam and chemical spray exposure. Insulation resistance measurements were taken during the exposure sequence. Subsequent to the exposures, hipot and mandrel bend tests were conducted. To determine the most severe cable aging sequence, cable insulation material samples were subjected to varied aging exposures to observe sequence-related and dose-rate-related material degradation.

7656 (PAEC(C)III-C—81003) Measuring attitudes towards nuclear and technological risks (computer programs in SPSS language). Leonin, T.V. Jr. (Philippine Atomic Energy Commission, Diliman, Quezon City). Apr 1981. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82703401.

A number of methodologies have been developed for measuring public attitudes towards nuclear and other technological risks. The Fishbein model, as modified by the IAEA Risk Assessment group, and which was found to be applicable for Philippine public attitude measurements, is briefly explained together with two other models which are utilized for comparative correlations. A step by step guide on the procedures involved and the calculations required in measuring and analyzing attitude using these models is likewise described, with special emphasis on the computer processing aspect. The use of the Statistical Package for the Social Sciences (SPSS) in the analysis is also described and a number of computer programs in SPSS for the various statistical calculations required in the analysis is presented.

7657 (PB—82-209867) Fission product heating effects after shutdown of the Scottish Universities Research Reactor with simulated bottom blockage of the core tanks. Riley, J.A.; Donald, S.R. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). Oct 1972. 33p. NTIS, PC A03/MF A01.

The investigation described in this report was carried out using the Scottish Universities' Research Reactor at East Kilbride, Scotland. Reactor tests have been performed in order to investigate, after reactor shutdown, the fuel plate temperature behavior under a simulated bottom blockage of the core tanks. This simulated blockage was obtained by either returning water to partially fill the core tanks, or sealing the dump tank ventilator pipe with polythene sheeting, immediately after reactor shut down.

7658 (RHO-RE-SA—8-Rev.1) Analysis of the Three Mile Island (TMI-2) hydrogen burn. Henrie, J.O.; Postma, A.K. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Jul 1982. Contract AC06-77RL01030. 37p. (CONF-830103—21-Rev.1). NTIS, PC A03/MF A01. Order Number DE82020725.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

Portions of document are illegible.

A study of recorded temperatures and pressures was made. Hydrogen concentrations were calculated. Postburn average ambient temperatures versus time were calculated. Average temperatures were calculated for the region above elevation 347, below elevation 347, and within the D-shield compartments. Results were: Prior to the burn, the hydrogen was well mixed with the containment air. Average hydrogen concentration was 7.9%, wet basis. The hydrogen burn occurred at all three levels in the containment. The burn was initiated somewhere in the lowest level, probably on the west side. The burn time was about 12 s. About 3570 m^3 or 126,000 ft^3, 160 kg moles or 319 kg of hydrogen burned. Containment gas temperatures in the flame front were 760°C (1400°F). Average containment gas temperature at end was 660°C (1220°F). The gas temperatures decreased much faster below elevation 347 than above elevation 347. The average temperature rise was only about 1.2°C (2.2°F) as a result of the hydrogen burn. Considerably more energy came from the hot water and steam vented. The burn damage observed was predominantly at the upper elevations and on the north, east, and south quadrants. 1.1% hydrogen remained in the containment after the burn. Venting of the reactor cooling system during the hour following the burn added an additional 0.6%. Hydrogen concentrations increased from this 1.7% to about 2.2% between March 30 and April 2. One of two Rockwell hydrogen recombiners removed 112 kg of hydrogen. A total of 459 kg of hydrogen gas were accounted for. Assuming that 432 kg were generated by the zirconium-steam reaction, 9850 kg Zr would have been oxidized.

7659 (SAND—82-0871C) Hydrogen production during delayed emergency core coolant injection. Prassinos, P.G.; Sherman, M.P. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 16p. (CONF-830103—17). NTIS, PC A02/MF A01. Order Number DE82018299.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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This report considers the effect of delayed emergency-core-coolant injection on hydrogen production by the zirconium-steam reaction during nuclear reactor accidents involving core uncovery. For the accident considered in this report, the Zr-H_2O reaction is limited by the availability of steam. Delayed coolant injection increases the rate of steam generation and therefore has the potential of increasing the hydrogen generation rate. Cooling of the reactor core by the increased steam and possible rise in the liquid water level tend to decrease the production rate of hydrogen. This study considers the relative importance of these two opposing effects on the rate and total amount of hydrogen generated. This study was performed using the MARCH (Meltdown Accident Response Characteristics) Code.

7660 (SAND—82-0903C) Simplified hydrodynamic model of hydrogen-flame propagation in reactor vessels. Baer, M.R.; Ratzel, A.C. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 25p. (CONF-830103—19). NTIS, PC A02/MF A01. Order Number DE82018295.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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The model is consistent with the theory of slow combustion in which the gasdynamic field equations are treated in the limit of small Mach numbers. To the lowest order, pressure is spatially uniform. The flame is treated as a density and entropy discontinuity which propagates at prescribed burning velocities, corresponding to laminar or turbulent flames. Radiation cooling of the burned combustion gases and possible preheating of the unburned gases during propagation of the flame is included using a molecular gas-band thermal radiation model. Application of this model has been developed for 1-D variable-area flame propagation. Multidimensional effects induced by hydrodynamics and buoyancy are corrected for. This model of flame propagation reduces to differential equations which describes the temporal variations of vessel pressure, burned volume and gas entropy. The thermodynamic state of the burned gas immediately following the flame is determined using an isobaric Hugoniot relation. At other locations the burned-gas thermodynamic states are determined using a Lagrangian particle tracking method. Results of a computer code using the method are presented. 11 figures.

7661 (SAND—82-0913C) Hydrogen combustion results from the Sandia intermediate-scale (VGES) tank and the Sandia critical-tube-diameter test facility. Cummings, J.C.; Benedick, W.B.; Prassinos, P.G. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 20p. (CONF-830103—16). NTIS, PC A02/MF A01. Order Number DE82018744.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

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Sandia National Laboratories is currently involved in several experimental projects to provide data that will help quantify the threat of hydrogen combustion during LWR accidents. One project, which employs several experimental facilities, is the Variable Geometry Experimental System (VGES). The purpose of this paper is to present descriptions of an experimental results from two of these facilities: an intermediate-scale burn tank (~ 5 m^3) and a critical-tube-diameter test facility.

7662 (SAND—82-0917C) Hydrogen combustion in aqueous foams. Baer, M.R.; Griffiths, S.K.; Shepherd, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 29p. (CONF-830103—20). NTIS, PC A03/MF A01. Order Number DE82019736.

From 2. international topical meeting on nuclear thermalhydraulics; Santa Barbara, CA, USA (11 Jan 1982).

Water fogs are an effective countermeasure to large-scale hydrogen combustion that might accompany loss-of-coolant. An alternate method of suspending the desired mass of water is via high expansion-ratio aqueous foams. Because, in practice, the foam would be generated using the combustible gaseous contents of the containment vessel, combustion occurs inside the foam cells. To assess the usefulness of aqueous foams in a mitigation plan, several open tube tests and over one hundred closed vessel tests of hydrogen/air combustion with and without foam were conducted. At low and intermediate hydrogen concentrations, the foam has little effect on the ultimate isochoric pressure rise. Above 15% hydrogen concentration, the foam causes a significant reduction in the pressure rise. The maximum effect occurs at about 28% hydrogen (the stoichiometric limit is 29.6% hydrogen) where the peak overpressure is reduced by two and one-half. Despite this overall pressure reduction, the flame speed is increased by up to an order of magnitude for combustion in the foam and strong pressure fluctuations are observed near a hydrogen concentration of 23%. 7 figures.

7663 (STUDSVIK-E1—82/55) Hydrogen evolution from aluminium in reactor containment spray solutions. Karlberg, G.; Sundvall, S.B. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 23 Mar 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702906.

Three different aluminium alloys were exposed to conditions similar to BWR and PWR containment spray waters at 50, 100 and 150°C. BWR deionized water gives corrosion rates of at most 0.05 mm/year and hydrogen concentrations less than 0.1-1%. On the contrary PWR alkaline solutions give very high corrosion rates and hydrogen contents.

7664 Accelerated aging speeds test of instrument reliability. Romo, E.A.; Richey, J.A. (ITT, USA). *Power;* **126**: No. 8, 61-62(Aug 1982).

Safety-related instrument in nuclear power plants must be checked for reliability over their projected operating life. A method of conducting accelerated aging tests is presentd. It uses the Arrhenius activation energy concept and manipulation of the

parameters of the test e.g. by raising test temperature, by relying on a model characterizing the chemical-related reactions of materials.

7665 **Gaseous fission product release predictions in TRISO HTGR fuel particles.** Kovacs, W.J. (Gen At Co, San Diego, CA, USA). *Journal of the American Ceramic Society;* 65: No. 3, 154-157(Mar 1982).

Structural integrity of SiC layers on TRISO-coated HTGR fuel particles is a critical property necessary to ensure fission-product retention. Characterization and detection of microcracks in SiC layers by high-pressure (69 MPa) mercury intrusion is discussed. Particular emphasis is placed on relating metallic and gaseous fission-product release to the level of defective SiC layers. Gaseous fission-product release during irradiation is shown to be more accurately predicted when the fraction of defective SiC layers as determined by mercury intrusion is taken into account. 11 refs.

7666 **Safety study for HTR-concepts designs under German siting conditions. Phase I B, Appendix II.** Juelich, Germany; Kernforschungsanlage (1982). 357p. (In German). (Juel-Spez—136/Bd.3). Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany.

The report presents the work carried out on systems, reliability and consequence analysis for core heatup accidents. Long-term failure of the main cooling system and loss of the electric auxiliary power supply, here defined as transients, are the dominating initiating events. The most important sequences of events as far as risk is concerned presume a failure to start in the auxiliary cooling system, which leads to a slow rise in temperature and pressure in the reactor core. Temperatures of the fuel elements reach failure limits after ten hours at the earliest. Substantial releases of fission products into the environment are, however, only to be expected either if the containment remains unisolated or if the containment fails due to overpressure. The earliest point at which structural failure could occur is about 4.5 days, the frequency is estimated at 10^{-6} per reactor year. The cause of failure of the reactor containment is loss of liner cooling which results in a danger of iguitable gas mixture, which, if they deflagrate, can subject the containment to stresses beyond its ultimate strength. However, it is much more probable that the liner cooling system and reactor containment will remain intact and that releases of fission products damaging to health will be completely avoided.

7667 **Reports on research work in the field of the safety of nuclear facilities financed by the Federal Minister of the Interior. Period under report: 1st October - 31th December 1980 (17th quarterly report on SR-projects).** Koeln, Germany; Gesellschaft fuer Reaktorsicherheit m.b.H. (1981). 80p. (In German). (GRS-F—101).

The BMI (Home Office) finances the performance of studies, expert's reports and other investigations in the field of the safety of nuclear facilities. The results of these studies (CSR-projects) are meant to contribute to the elucidation of still open questions concerning the atomic licensing procedure. The GRS, who are charged by the BMI, give regular information on the state-of-affairs of such investigations. This is done quarterly resp., annually by editing progrss reports within the report series GRS-F. These reports serve to inform the authorities of the Bund and Laender afflicted as well as the reactor safety commission. Each progress report presents a compilation of individual reports arranged according to subject fields. These are written by the contractors themselves in a standardized form as a documentation of the progress of their work and edited by the supervisory board of the GRS (GRS-FB) within the framework of the general information on progress within the investigations on the safety of nuclear facilities. The individual reports are marked in the order of their arrangement with successive numbers. Each report contains, among other things, data on the objective targets, the work performed, the results gained and the continuation of work planned.

7668 **BODYFIT-1 simulation of flow rundown conditions in a 7-Pin Bundle.** Chen, B.C.J.; Sha, W.T. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* 35: 663-664(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 7246

7669 **Energy storage and the energy systems.** Kurti, N. pp 3-20 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Storage does not save energy but forms nevertheless an important part of energy strategies. It enhances the use of the renewable energy sources and permits the more efficient use of high capital cost conversion plant. After surveying the main objectives of energy consumption the paper lists the energy sources provided by nature, the forms in which energy is used by society and the storage periodicity needed for various combinations of source and use, in particular for electricity production. The paper concludes with a review and comparison of various storage methods.

2502 Compressed Gas

7670 **(EPRI-EM—2351-Vol.5-Pt.1) Compressed-air energy storage preliminary design and site development program in an aquifer. Volume 5, Part 1. Turbomachinery design. Final report.** Berman, P.A.; Bonk, J.S.; Kobett, W.F.; Kosanovich, N.S.; Long, L.J.; Marinacci, D.J. (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.; Public Service Co. of Indiana, Inc., Plainfield (USA)). Nov 1982. Contract AC02-78ET29232. 564p. NTIS, PC A24/MF A01. Order Number DE83004005.

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This report, Volume 5, Part 1, documents the development of the design approach for a combustion-turbine heat cycle and the major mechanical equipment for use by an electric utility at a selected aquifer air storage site. A compressed-air energy storage (CAES) system utilizes off-peak electric power, available from base-load power plants, to store compressed air underground in an aquifer. During subsequent periods when intermediate or peaking combustion turbines are normally employed, the stored air is extracted from the aquifer and used as an air supply for a generating combustion-turbine expander. The site selected for this study is Media, Illinois, where the aquifer has an initial discovery pressure of 840 psia. An initial air injection temperature of 150°F was selected. The major mechanical equipment considered in this study includes the turbine-motor/generator-compressor train, intercooler and aftercooler system, and the exhaust-gas regenerator. The cycle and machinery configuration and the specific mechanical equipment were selected on the basis of the Media site characteristics. These characteristics and the effect of component interdependency were considered when a conservative component design approach was established that satisfies the Media site CAES system requirements.

7671 **(EPRI-EM—2351-Vol.5-Pt.2) Compressed-air energy storage preliminary design and site development program in an aquifer. Volume 5, Part 2. Appendix F. Dynamic system computer model. Final report.** Berman, P.A.; Bonk, J.S.; Kobett, W.F.; Kosanovich, N.S.; Long, L.J.; Marinacci, D.J. (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.; Public Service Co. of Indiana, Inc., Plainfield (USA)). Nov 1982. Contract AC02-78ET29232. 508p. NTIS, PC A22/MF A01. Order Number DE83004004.

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This report presents Appendix F (Part 2) of Volume 5, which addresses the turbomachinery design portion of a study examining an aquifer-based compressed-air energy storage (CAES) plant. Appendix F documents the computer program and subroutines written to provide a general-purpose modeling tool for a CAES power plant system. The CAES plant was modeled using FORTRAN and a Control Data Corporation 7600 digital computer. The system model was developed to: determine the transient response characteristics of the complete CAES plant; provide a tool for evaluating the requirements and performance of control systems proposed for the CAES plant; provide a general-purpose digital-computer-based dynamic modeling tool; and provide power plant

component models as FORTRAN subroutines that can be used, with appropriate parameter data, as modules in complete CAES power plant models.

2504 Capacitor Banks

REFER ALSO TO CITATION(S) 7066

2505 Flywheels

7672 **(EUR—7088-DE) Stationary flywheel energy accumulators.** Gilhaus, A.; Hau, E.; Gassner, G.; Huss, G.; Schauberger, H. (Commission of the European Communities, Luxembourg). 1981. 159p. (In German). Amt fuer amtliche Veroeffentlichungen der Europaeischen Gemeinschaften, Luxembourg.

The aim of this systemstudy is to find out industrial applications of Stationary Flywheel Energy Accumulators. The economic value for the consumer and the effects on the power supply grid should be investigated. Up to now Stationary Flywheel Energy Accumulators have only been used in a small range. The main reason for thinking of the application in a wider range was the hope that those could be used economically for lowering the demanded maximum output of the power supply grid. The possible savings in energy costs however proved out to be too small for paying back the investment costs. Further benefits are necessary for advantageous application. As to overall economy, compensation of short time maximum power output seems to be more favourable at the power stations. An additional possibility for energy storage by flywheels is given where otherwise lost energy can be used effectively, according to the successful brake energy storage in vehicles. Under this aspect the future use of flywheels in wind-power-plants seems to be promising. Attractive savings of energy can be obtained by introducing modern flywheel technology for emergency power supply units which are employed for instance in telecommunication systems. Especially the application for emergency power supply, in power stations and in combination with wind energy converters need further investigation.

2506 Thermal

REFER ALSO TO CITATION(S) 7188, 7822

7673 **(EUR—7065-DE) Investigations of latent heat storage materials for use in the medium and high temperature ranges.** Heine, D.; Heess, F.; Steiner, D. (Commission of the European Communities, Luxembourg). 1981. 95p. (In German). Amt fuer amtliche Veroeffentlichungen der Europaeischen Gemeinschaften, Luxembourg.

Experimental investigations are carried out of the long-term behavior of latent heat storage materials for use in the temperature ranges 200 to 450°C and 700 to 900°C. These investigations comprise the corrosion of structural materials together with promising storage materials and the thermal stability and the melting and freezing behavior of these storage materials. From the corrosion tests the mass loss of sheet metal samples is measured and thickness reduction and corrosion rate are calculated. Futhermore the corrosion type is determined using optical and scanning electron microscopes. During cyclic tests melting and freezing curces are continually measured. Thereby the thermal stability of the storage materials as a function of melting and freezing is determined. The combinations mild steel with $NaNO_3$, boiler steel with KCl-$ZnCl_2$, $NaNO_3$ and $MgCl_2$-$NaCl$ and $NiCu30Fe$ with KCl-$ZnCl_2$ are compatible (temperature range 200-450°C). In the temperature range 700 to 900°C the structural materials are badly corroded.

7674 **(IKE—5TF-365-80) Investigation of materials used in medium and high temperature latent heat storage equipment.** Heine, D.; Heess, F.; Steiner, D. (Institut fuer Kerntechnik und Energiewandlung e.V., Stuttgart (Germany, F.R.)). Mar 1980. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750677.

Experimental investigations are carried out of the long-term behavior of latent heat storage materials for use in the temperature ranges 200 to 450°C and 700 to 900°C. These investigations comprise the corrosion of structural materials together with promising storage materials and the thermal stability and the melting and freezing behavior of these storage materials. From the corrosion tests the mass loss of sheet metal samples is measured and thickness reduction and corrosion rate are calculated. Furthermore the corrosion type is determined using optical and scanning electron microscopes. During cyclic tests melting and freezing curves are continually measured. Thereby the thermal stability of the storage materials as a function of melting and freezing is determined. The combinations mild steel with $NaNO_3$, boiler steel with KCl-$ZnCl_2$, $NaNO_3$ and $MgCl_2$-$NaCl$ and $NiCu30Fe$ with KCl-$ZnCl_2$ are compatible (temperature range 200 to 450°C). In the temperature range 700 to 900°C the structural materials are badly corroded.

7675 **Dimensionless parameter approach to the thermal behavior of an aquifer thermal energy storage system.** Doughty, C.; Hellstroem, G.; Tsang, C.F.; Claesson, J. (Lawrence Berkeley Lab, CA, USA). *Water Resources Research;* **18**: No. 3, 571-587(Jun 1982).

This study considers the thermal behavior around a storage well in the case when buoyancy effects can be neglected. A dimensionless formulation of the energy transport equations for the aquifer system is presented, and the key dimensionless parameters are discussed. A numerical model using a steady flow field is used to simulate heat transport in the aquifer and confining layers around the injection/production well during the aquifer thermal energy storage cycle. The key parameters are varied in order to understand their influence on the percent of the injected energy that can be recovered and the temperature of the extracted water. The results are presented graphically. 26 refs.

7676 **Thermal energy storage.** Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982). 511p. Kluwer Boston Inc., 190 Old Derby St., Hingham, MA 02043.

Seventeen papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

7677 **Sensible heat storage.** Mancini, N.A.; Simone, F. (Universita di Catania, Italy). pp 21-32 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

The use of liquids, e.g., as water, oils, molten salts, and solids, e.g., rock beds, for sensible heat storage are compared on the basis of storage capacity, equipment requirements and cost. It is concluded that although the equipment for rock bed storage costs 1/3 to 1/2 that for water storage in steel tanks, the operating costs for distributing air in the rock bed system are much higher than for the water system. Therefore, the rock bed system will have a comparable or even higher cost than a water system of the same heat capacity. (LCL)

7678 **Low temperature latent heat thermal energy storage.** Abhat, A. (Univ. of Stuttgart, Germany). pp 33-91 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

This paper reviews heat-of-fusion storage materials and heat exchangers for low temperature latent heat storage in the temperature range 0 to 120°C. The melting and freezing behavior of commercial paraffins, fatty acids, inorganic salt hydrates and eutectics investigated using differential scanning calorimetry and thermal analysis techniques is discussed. Following a brief presentation of active and passive heat exchangers, the heat transfer considerations in a latent heat store are described in detail through the examples of a finned heat pipe and a finned-annulus heat exchanger. Finally, some data pertaining to the current economics of latent heat stores are provided.

7679 **Storage in the ground.** de Marsily, G. (Ecole Nationale Superieure des Mines de Paris, Fontainebleau, France). pp 145-177 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

After a brief examination of why and how energy is stored, the problem of heat storage in the ground in impervious and porous media saturated with water is described. The equations for heat transfer in natural medial, and a summary of the ideas, experiments and projects in this field, are given. The technique of aquifer heat storage appears promising for the storage of around a million megacalories, but there are still some problems which are not yet completely solved.

7680 **Thermal energy storage for the recovery of industrial waste heat.** Wood, R.J. (Cranfield Inst. of Tech., Bedfordshire, England). pp 219-263 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Waste heat recovery systems are of prime importance to the efficient use of energy in industrial processes. Although most waste heat recovery systems have been of the non-storage type, future trends may well see a significant increase in the use of Thermal Energy Storage (TES). This will be necessary in order to expand the rational use of large waste heat sources, to match temporally the cyclic variations of hitherto independent thermal processes and to permit the possibility for energy cascading and storage to overcome imbalances in plant energy systems. This paper seeks to describe some of the characteristics of industrial energy use, the currently available information on temperature levels, working fluids, process periodicity and technological options available for storing industrial waste-heat.

7681 **Thermal energy storage for peaking power generation.** Gilli, P.V. (Graz Univ. of Tech., Austria); Beckmann, G. pp 265-300 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Energy storage in electric grids leads to better utilization of base load plants and thus to the substitution of premium fuel, to operational advantages and to lower system cost, in particular when the proportion of nuclear or solar power plants increases. Thermal energy storage (TES) plants, integrated in the power plant itself, are mainly based on pressurized hot water in conventional or advanced pressure vessels, above or below ground, and on the steam storage, the feed water storage or the cascading arrangement. Advantages of TES include: no additional energy conversions; practically no limitation of charging power; high turnaround efficiency.

7682 **Overview of the thermal storage work within the Energy R and D programme of the European Community.** Zegers, P. (Commission of the European Communities, Brussels, Belgium). pp 443-463 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

This overview is divided in three parts. First the CEC Energy R and D program is described in which research on thermal storage is carried out. Then a general state of the art is given for heat storage R and D giving the advantages and disadvantages of the best known heat storage systems, listing the most important applications, and making some rough estimates on their economic feasibility. Finally the results and conclusions of CEC thermal storage research are discussed. This work includes latent heat storage with paraffins and inorganic salts, studies on chemical heat storage and long term heat storage with hot water storage tanks, pebble beds, solar ponds and aquifers.

7683 **United States Department of Energy Thermal Energy Storage Program.** Swisher, J.H. (Dept. of Energy, Washington, DC); Frier, W.A. pp 465-500 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982). Contract AC06-76RL01830.

The objective of the US Department of Energy Thermal Energy Storage Program is to develop devices, processes, and subsystems that permit domestic energy resources to be supplied at the time and locations where they can be used. The program emphasis is in five principal areas: (1) daily storage for active or passive solar and conventional heating and cooling; (2) seasonal storage for building heating and cooling; (3) thermal energy transport; (4) thermal power storage; and (5) chemical heat pumps. The program has a budget of $15.35 million for 1981.

2508 Chemical

REFER ALSO TO CITATION(S) 7085, 7087

2509 Batteries

7684 **(AD-A—114542/4) Comparison of anodic dischargability of Li-B alloy with pure Li in LiC10 sub 4 - propylene carbonate. Final report 1977-1979.** James, S.D. (Naval Surface Weapons Center, Silver Spring, MD (USA)). Apr 1981. 27p. NTIS, PC A03/MF A01.

Li-B alloy discharges comparably with pure Li in PC-LiC_{10} sub 4 and 23 deg C. The alloy may find useful application where safety considerations permit sacrificing some coulombic capacity versus unsupported Li. Measurement of electrochemical Li utilization suggests the alloy is a mixture of elemental Li plus a Li-B compound whose stoichiometry is in the vicinity of 'Li sub 7 B sub 6'.

7685 **(BMFT-FB-T—82-078) Electronic conductivity of the active masses of lead-acid batteries during discharge and cycle-life.** Metzendorf, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750720.

Until now lead-acid batteries perform only about 60% of their theoretical capacity. Theories of two-phase resistor networks show an insulating behaviour if there is more than a special amount of a bad-conducting phase. It is near at hand to estimate such a mechanism in the electrodes of lead-acid batteries. Electrical and structural properties of positive and negative grid-plate electrodes are investigated during a single discharge and during cycle-life. The results show that it is possible to discribe the utilisation of the electrodes during a single discharge at low current densities with these theories. The discharge will be stopped by the break-down of the electronic conductivity of the active masses. From the results a model is developed from which it is possible to calculate current distribution during discharge al low current densities. From this conclusions are drawn to the discharge behaviour at high current densities. However, relation between electronic conductivity and cycly-life can not be found. Proposals are made for construction of better electrodes which follow from the relation between structure and electronic conductivity.

7686 **(SAND—82-2466C) Storage battery systems analysis.** Murphy, K.D. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 3p. (CONF-821211—1). NTIS, PC A02/MF A01. Order Number DE83002510.

From 5. DOE battery and electrochemical contractor's conference; Crystal City, VA, USA (7 Dec 1982).

Portions of document are illegible.

Storage Battery Systems Analysis supports the battery Exploratory Technology Development and Testing Project with technical and economic analysis of battery systems in various end-use applications. Computer modeling and simulation techniques are used in the analyses. Analysis objectives are achieved through both in-house efforts and outside contracts. In-house studies during FY82 included a study of the relationship between storage battery system reliability and cost, through cost-of-investment and cost-of-service interruption inputs; revision and update of the SOLSTOR computer code in standard FORTRAN 77 form; parametric studies of residential stand-alone photovoltaic systems using the SOLSTOR code; simulation of wind turbine collector/storage battery systems for the community of Kalaupapa, Molokai, Hawaii.

7687 **(UCRL—15473) Effect of manganese additions on the performance of aluminum air-battery anode alloys.** Scott, D.H. (Reynolds Metals Co., Richmond, VA (USA)). 5 May 1982. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01. Order Number DE83002277.

Portions of document are illegible.

Lawrence Livermore Laboratories' (LLL) electrochemical evaluation of the experimental alloys previously cast indicated that the coulombic efficiency of an aluminum anode alloy with a nomi-

nal chemistry of 0.04% Fe, 0.04% Ga, and 0.8% Mg could be substantially improved by a 0.04% Mn addition. More recent electrochemical testing of ingot sections performed by both Reynolds and LLL showed that the performance of an aluminum anode alloy, based on a nominal 0.04% Fe, could be improved by a high temperature homogenization. Based on these results, it was decided that the addition of manganese offered a very fruitful approach for providing improved anode performance. Thus the intent of the current work was to further investigate the effects of varying manganese/iron ratios and fabrication practices on the electro-chemical performance of an aluminum anode alloy containing a nominal 0.04% Fe. Results are presented and discussed.

7688 **Bifunctional air electrodes containing elemental iron powder charging additive.** Demczyk, B.G.; Gongaware, P.R.; Liu, C. (to Dept. Of Energy). US Patent 4,341,848. 27 Jul 1982. Filed date 5 Mar 1981. vp.

PAT-APPL-240659.

A bifunctional air electrode for use in electrochemical energy cells is made, comprising a hydrophilic layer and a hydrophobic layer, where the hydrophilic layer essentially comprises a hydrophilic composite which includes: (I) carbon; (II) elemental iron particles having a particle size of between about 25 microns and about 700 microns diameter; (III) an oxygen evolution material; (IV) a nonwetting agent; and (V) a catalyst, where at least one current collector is formed into said composite.

7689 **Ternary compound electrode for lithium cells.** Godshall, N.A.; Huggins, R.A.; Raistrick, I.D. (to Dept. Of Energy). US Patent 4,340,652. 20 Jul 1982. Filed date 30 Jul 1980. vp.

PAT-APPL-173554.

Lithium-based cells are promising for applications such as electric vehicles and load-leveling for power plants since lithium is very electropositive and of light weight. One type of lithium-based cell utilizes a molten salt electrolyte and normally is operated in the temperature range of from 350° to 500° C. Such high temperature operation accelerates corrosion problems. The present invention provides an electrochemical cell in which lithium is the electroactive species. The cell has a positive electrode which includes a ternary compound generally represented as li-m-o, wherein M is a transition metal. Corrosion of the inventive cell is considerably reduced.

7690 **Containers for use in a self supporting assembly.** Gillespie, P.J. (to Dept. Of Energy). US Patent 4,339,049. 13 Jul 1982. Filed date 17 Apr 1980. vp.

PAT-APPL-141075.

This invention is directed to a container having side walls and end walls forming a body having a generally rectangular cross-section. Means for restraining lateral and rotational movement of the container relative to an adjacent container while allowing relatively unhindered movement perpendicular to the side walls is also included. The lateral and rotational movement is restrained in a plane parallel to the side walls. The means include a projection connected to at least one of the side walls and extending outwardly therefrom to engage the adjacent container. Also part of this invention is an assembly of containers which includes a plurality of the above described containers arranged side by side with the end walls generally coplanar and the side walls generally parallel. Means for restraining movement perpendicular to the side walls of the plurality of containers is also included. Each of the containers may house a plurality of battery electrodes.

7691 **Preparation of powders suitable for conversion to useful beta -aluminas.** Morgan, P.E. (to Dept. Of Energy). US Patent 4,339,511. 13 Jul 1982. Filed date 16 Apr 1981. vp.

PAT-APPL-254710.

A process for forming a precursor powder which, when suitably pressed and sintered forms highly pure, densified beta - or beta "-alumina, comprising the steps of: (1) forming a suspension (Or slurry) of bayer-derived al(Oh)3 in a water-miscible solvent; (2) adding an aqueous solution of a mg compound, a li compound, a na compound or mixtures thereof to the bayer-derived al(Oh)3 suspension while agitating the mixture formed thereby, to produce a gel; (3) drying the gel at a temperature above the normal boiling point of water to produce a powder material; (4) lightly ball milling and sieving said powder material; and (5) heating the ball-milled and sieved powder material at a temperature of from 350° to 900° C. To form the beta - or beta "-alumina precursor powder. The precursor powder, thus formed, may be subsequently isopressed at a high pressure and sintered at an elevated temperature to produce beta - or beta "-alumina.

7692 **Vibrating zinc electrodes in Ni/Zn batteries.** Ming-Biann, L.; Cook, G.M.; Yao, N.P.; Selman, J.R. (Argonne Natl Lab, IL, USA). *Journal of the Electrochemical Society;* **129**: No. 5, 913-920(May 1982).

In electrochemical processes where diffusion is rate controlling, the use of vibrating electrodes may result in an increase in the average mass transfer rate. The mechanism for the increase is that vibration changes the pattern of free convective flow developed during the process into a different flow pattern. Four models for the mass transfer enhancement are reviewed and modified. Vibrating zinc electrodes in Ni/Zn batteries (Vibrocel) are analyzed. The analyses include fluid dynamics, mass transfer, and electrochemical deposition phenomena. Three types of fluid flows are considered. The first, free-convective flow, is induced by the difference in density of the electrolyte near the electrode and in the bulk. The other two types, induced by the vibration of the zinc electrodes, are a periodic flow consisting of an oscillatory bulk flow and an oscillatory boundary flow, and a steady streaming near the upper and lower edges of the electrodes. The mass-transfer coefficients of zincate and hydroxide ions are calculated. 48 refs.

7693 **Phase relationships in positive electrodes of high temperature Li-Al/LiCl-KCl/FeS/sub 2/ cells.** Tomlczuk, Z.; Tani, B.; Otto, N.C.; Roche, M.F.; Vissers, D.R. (Argonne Natl Lab, Ill, USA). *Journal of the Electrochemical Society;* **129**: No. 5, 925-931(May 1982).

The phases present in FeS/sub 2/ electrodes operated in LiCl-KCl eutectic electrolyte were determined by x-ray diffraction and by metallographic examination. The phases were FeS/sub 2/, KFeS/sub 2/, Li/sub 3/Fe/sub 2/S/sub 4/, Li/sub 2.33/Fe/sub 0.67/S/sub 2/, Fe/sub 1-x/S, Li/sub 2/FeS/sub 2/, LiK/sub 6/Fe/sub 24/S/sub 26/Cl, Li/sub 2/S, and Fe. The metallographic and crystallographic characteristics of these phases are presented. The sequence of Li-Fe-S phases in the FeS/sub 2/ electrode was in accord with the sequence predicted from the equilibrium Li-Fe-S phase diagram. Two of the Li-Fe-S phases found at room temperature (Li/sub 2.33/Fe/sub 0.67/S/sub 2/ and Li/sub 2/FeS/sub 2/) result from decomposition on cooling of a solid solution phase: Li/sub 2+x/Fe/sub 1-x/S/sub 2/ (O/less than equivalent to/x/less than equivalent to/0.33). This work is pertinent to vehicle propulsion and off-peak energy storage. 18 refs.

7694 **Cluster-variation method for the triangular lattice gas.** Osorio, R.; Falicov, L.M. (Univ of California, Berkeley, USA). *Journal of Physics and Chemistry of Solids;* **43**: No. 1, 73-79(1982).

A triangular lattice gas with nearest-neighbor repulsions and three-particle attractions is examined in a three-sublattice triangle approximation as a model for lithium intercalation in the transition metals dichalcogenides. Order-disorder phase diagrams and thermodynamic functions are computed. Some peaks in the incremental capacity as function of concentration in the experimental data of A.H. Thompson are reproduced in the model. 25 refs.

7695 **Cycles till failure of silver-zinc cells with competing failure modes - Preliminary data analysis.** Sidik, S.M.; Leibecki, H.F.; Bozek, J.M. (NASA, Lewis Research Center, Cleveland, Ohio). pp 46 of American Statistical Association, annual meeting. Cleveland, OH; NASA, Lewis Research Center (1980).

The data analysis of cycles to failure of silver-zinc electrochemical cells with competing failure modes is presented. The test ran 129 cells through charge-discharge cycles until failure. Preliminary data analysis consisted of response surface estimate of life. Batteries fail through low voltage condition and an internal shorting condition. A competing failure modes analysis was made using maximum likelihood estimation for the extreme value life distribu-

tion. Extensive residual plotting and probability plotting were used to verify data quality and selection of model.

29 ENERGY PLANNING AND POLICY

7696 (NP—2901259) Energy policy 1980 of Lower Saxony. (Niedersaechsischer Minister fuer Wirtschaft und Verkehr, Hannover (Germany, F.R.)). 1981. 114p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82901259.

The second petroleum crisis of 1979 and the exorbitant rises of petroleum prices caused the problem of energy supply which is only now being felt. The import of mineral oil left significant marks in the balance of goods and services. This deficiency makes stability of West German currency suffer. The rate of inflation is on a level which had not been seen in Germany in the past 5 years. Taking this as a background, the Government of Lower Saxony decreed an energy program trying to meet these challenges with the means available. It shows ways of substituting mineral oil by coal and nuclear energy using the existing energy sources in a more economical and rational way, and also by using renewable energy sources.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 8278

7697 (BMFT-FB-T—82-080) Reliability and safety of power systems. Heiner, G.; Kochs, H.D.; Schmidt, S.; Brauner, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 207p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE82750721.

The following paper contains the final report on the prematurely terminated project 'Reliability and Safety of Power Systems'. The results achieved by the three contributing institutions are documented in separated parts of this report. Approaches to reliability and safety analysis are investigated and compared with regards to their applicability. On the basis of these investigations two computer programs are developed. A cut set program calculates the availability of complex systems consisting of statistically independent components. Another program evaluates all the reliability indices characterizing the stationary behaviour of homogeneous Markovian processes. The second subproject is devoted to reliability modeling of control systems features. Special concern is given to the discrimination of failure modes (component or bus failure, computer shutdown) and maintenance modes (single component maintenance, computer test). Methods for reliability evaluation are applied to concrete examples. The third subproject is concerned with transmission reliability calculation in relation to the reliability of protective relays. Appropriate methods are worked out and applied to a busbar protective system.

7698 (IPP—4-192) Self-reproduction time of advanced energy systems. Knobloch, A.F. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1979. 5p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82902221.

Using very simple assumptions it is shown that advanced energy systems - including a possible fusion reactor - involving prolonged self-reproduction times compared to present systems can become more interesting as the rate of increase in energy demand is slowing down. With the present rates of increase advanced systems would require unreasonably large additional amounds of installed power for renewal and enlargement surpassing the demand from the consumers. Another important possibility of diminishing this additional installed power can come from increasing the lifetime of advanced energy systems.

7699 Assessment of the long-term energy-analysis program used for the EIA 1978 Report to Congress. Weisbin, C.R.; Peelle, R.W.; Alsmiller, R.G. Jr. (Oak Ridge Natl Lab, TN). *Energy (Oxford);* 7: No. 2, 155-170(Feb 1982).

The Long-Term Energy Analysis Program (LEAP), a computer model of the energy portion of the U.S. economy that was used by the Energy Information Administration (EIA) of the U.S. Department of Energy (DOE) for the 1995-2020 projections in its 1978 Annual Report to Congress, is evaluated here. Essential considerations include (1) the adequacy of its documentation, (2) the evaluator's experience in operating the model, (3) the adequacy of the numerical techniques used, (4) the soundness of the economic and technical foundations of the model equations, and (5) the degree to which the computer program has been verified. To show which parameters strongly influence the results and to approach the question of whether the model can project important results with sufficient accuracy to support qualitative conclusions, the numerical sensitivities of some important results to model input parameters were obtained using a novel adjoint technique. This technique enabled efficient determination of first derivatives of results of interest with respect to all input data (approximately 1600 non-zero sensitivities). Direct recalculation of the model with altered data sets was used to confirm the results and to assess the extent of nonlinear effects. The input data are categorized and discussed, and uncertainties are given for some parameters as examples. 30 refs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 6922, 7111, 7762, 7794, 7825, 7859, 8278, 8355

7700 (CONF-8009287—1) Problems of West German economic development in the Eighties. Schneider, H.K. (Suedhessische Gas und Wasser A.G., Darmstadt (Germany, F.R.)). [nd]. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906255.

From Anniversary of the Suedhessische Gas Wasser A.G. meeting; Darmstadt, F.R. Germany (19 Sep 1980).

In this official speech, some basic thoughts are raised concerning energy supply and economic development in West Germany during the next few years.

7701 (NP—3900253) Extraction, fixed costs and the Hotelling rule. Siebert, H. (Mannheim Univ. (Germany, F.R.). Fakultaet fuer Volkswirtschaftslehre und Statistik). 1981. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83900253.

Starting from the matter of fact that in the extracting industry large-scale investments and fixed costs play an important role the influence of fixed extraction costs and a convex curve on the time path of extraction is investigated. Moreover the time path of extraction is investigated for the case of the explicit introduction of demand and when markets are assumed to clear. The increase in fixed costs or the downward shift of the demand curve will eventually make it uneconomical to extract for instance the petroleum resource or mineral resource. The statements of the investigation is supported by a mathematical model.

7702 (PB—82-211533) Implementing financial incentives for alternative energy development. Executive summary (final). (Peat, Marwick, Mitchell and Co., San Francisco, CA (USA)). Apr 1981. 17p. NTIS, PC A02/MF A01.

This report evaluates and recommends for further study a variety of financial incentives to accelerate alternative energy developments within the state of California, and develops strategies and identifies requirements for implementing those incentives with the most potential.

7703 Military-agrarian complex in the re-Africanization of Africa: rustic soldiers as traditionalizers. Mazrui, A.A. (Univ. of Michigan, Ann Arbor). pp 91-117 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The role of the military as agents of modernization in Africa is disucssed in this presentation. In particular, Uganda's military regime under Marshall Idi Amin is examined. The basic hypothesis of the author is that evidence from one part of Africa can be used to formulate likely trends in other parts of the Continent. The

author points out links in military regimes to western civilization in organization. The military plays a critical economic role which hastens industrialization and accelerates urbanization. Opposing views are also presented. Conflicts between the cultural backgrounds of the people and westernized African intellectuals are discussed. The author concludes that the cultural influence of Europe is stronger in Western Africa and that the process of modernization is likely to go faster in those areas than in Uganda, Zaire, or Kenya. (RJC)

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 6944, 7012, 7577, 7718, 7719, 7879, 8286, 8323, 8324, 8325, 8326, 8327, 8328

7704 (CONF-810140—, pp 6-18) **Energy-efficient community design.** Mosena, D.R. (American Planning Association, Chicago, IL). Feb 1981. NTIS (US Sales Only).

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

The farm and function of an energy-efficient community was discussed. Elements which can be incorporated into urban design were presented along with an overview of energy management examples across the US.

7705 (CONF-810140—, pp 19-26) **Energy planning process, available methodologies.** Kleinman, R. (NACo Research Inc., Washington, DC). Feb 1981. NTIS (US Sales Only).

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

The speaker summarized the major energy planning methodologies currently in practice. Both comprehensive and project-oriented approaches to energy management were discussed. He emphasized that the testing phase for all demonstration efforts are currently appraising national applicability.

7706 (CONF-810140—, pp 68-77) **Special role of community participation in energy planning.** Blasius, W. (Energy Planner, MPC, Knoxville, TN). Feb 1981. NTIS (US Sales Only).

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

A description of Knoxville-Knox County's citizen participation elements during the DOE Comprehensive Community Energy Management Program is given. Strengths and problems are reviewed with the importance of energy education emphasized. (PSB)

7707 (NP—3900252) **We find an approach to calculating the environment.** (Gesellschaft fuer Umweltsimulation e.V., Pfinztal-Berghausen (Germany, F.R.)). [nd]. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83900252.

GUS is a non-profit society of environmental engineering-engineers and -scientists in research, business and public corporations. We are the agent for contact, communication and congress on this topic and the partner of producer and applicator in simulation engineering.

7708 **Problems and outline solutions in the assessment of costs relating to environmental protection and pollution control and the public funds required.** Keiter, H.; Zimmermann, K. Berlin, Germany; Wissenschaftszentrum (1981). 20p. Wissenschaftszentrum Berlin, Germany.

Also published in: Z. Umweltpolit. (1982) (no.1).

A general analysis of the problems and alternative solutions concerning the classification, allocation and prognosis of public environmental expenditures, is presented. The article describes and analyses the basic means of evaluating environmental costs via the so-called 'Funktionenplan' representing the functional characteristics of the public budgets on the one hand, and via the construction of cross section budgets, on the other hand.

7709 **Environmental policy and the pollution control industry and their contributions to achieving an economic stabilization.** Zimmermann, K. Berlin, Germany; Wissenschaftszentrum (1981). 23p. (In German).

The impact of environmental policy on the economy is analyzed in a level and structure oriented approach. According to the political weight the article focuses first on the macroeconomic interdependencies of environmental policy. The second part of the article concentrates on the theoretical effects of an uprising environmental control industry on economic stabilization.

7710 **Structure and economic importance of the pollution control industry in the Federal Republic of Germany.** Ullmann, A.A.; Zimmermann, K. Berlin, Germany; Wissenschaftszentrum (1981). 35p. (In German).

Also published in: Z. Umweltpolit. (1981) (no.3).

Based on estimations of the demand for pollution control equipment and services various studies have been carried out with special emphasis on employment effects. Starting from the supply side, an analysis of the pollution control industry (PCI) is presented, concentrating on generally neglected aspects such as historical data of the industry, innovative effects, employment effects, sectoral and regional aspects, development of the respective markets in the past as well as for the future. The study is based on interviews with representatives of 693 companies and analysis of secondary statistical data. The results can be sketched as follows: The regional as well as the employment effects of the PCI are minor except for impacts of modernization in old industrial areas and with regard to highly qualified employees. However, the PCI is a catalyst for innovations for the whole economy, which also guarantees a dynamic development in the future. This finding is not only consistent with the PCI's perceptions but validated through objective data.

2904 Natural Resources

REFER ALSO TO CITATION(S) 7726

7711 (EUR—7075-DE) **Stock report and prospects - with an annex on non-technical aspects.** Haerter, M.; Lindner, R. (Commission of the European Communities, Luxembourg). 1981. 237p. (In German). Amt fuer amtliche Veroeffentlichungen der Europaeischen Gemeinschaften, Luxembourg.

This study is a compilation of the basic data of energy supply. The chapters deal separately with the world energy situation, as well as in the European Communities, and in the F.R. of Germany, with the supply and demand analysis. Furthermore, General principles of forecast and assessment methodology are discussed. The concluding chapter discusses the problem in the context of industry, politics, and culture, the substitutionability of energy, the relations to the environment and food chain contamination, coping with the future as a control problem, and some non-technical problems of the energy shortage.

7712 **Ceramic raw materials and their management.** Goeller, H.E. (Oak Ridge National Lab., TN). *American Ceramic Society Bulletin;* **61**: No. 4, 497-501, 505(Apr 1982).

Availability and management of raw materials used in the ceramics industry are discussed. Subjects covered include domestic and world resources, import problems, substitution and recycling, capacity and production, and synthesis of conventional and new minerals. Emphasis is on long-term world problems. 1 ref.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 7739, 7740, 7742, 7760, 7766, 7767, 7769, 7772, 7775, 7777, 7788

7713 (NP—2902413) **Energy Research, Development and Demonstration in New Zealand Volume 2, 1979/80. Tecnical Publication No. 10.** (Ministry of Energy, Wellington (New Zealand)). Mar 1981. 335p. NTIS (US Sales Only), PC A15/MF A01. Order Number DE82902413.

A summary of all energy research, development, and demonstration undertaken in New Zealand during the year ending March 1980 is presented. Expenditures on energy research and development in 1979/1980 are shown with comparative figures for 1978/1979 and estimates for 1980/1981 and 1981/1982 given. Data on manpower in research groups are provided. Approximately 200 summary sheets for individual projects are included in the following areas: conservation in industry, residential and commercial sectors, and transportation; alternate transport fuels; oil and gas refining and storage; coal production, transport, combustion, conversion; and properties; solar heating and cooling; solar energy, wind power; biomass production and utilization; geothermal resources; hydroelectric power; power conversion; energy system analysis; and power generation and transmission. (MCW)

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 6923, 7012, 7040, 7486, 7716, 7752, 8776

7714 **Nuclear fuel cycle: issues and some answers for the USA.** Harms, W.O. (Oak Ridge Natl Lab, TN). *Journal of the Energy Division (American Society of Civil Engineers);* **108**: No. EY2, 91-103(Jun 1982).

The paper presents background information on the nuclear fission energy concept and its role in the mid and long term; identifies the relevant nuclear fuel cycle issues confronting the United States; presents and examines some answers or direction concerning these issues, especially those that appear to be emerging in the formulation of a new national policy on nuclear energy; and describes some recent engineering innovations in remote chemical re-processing and automated fabrication of recycled fuels. 8 refs.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 6948

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 7247, 7253, 7743, 7831

7715 (CONF-8105173—, pp 9p, Paper 11) **District heating on the basis of co-generation plants reduces the local level of air pollution - facts and problems.** Braun, W. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

Since the oil crisis in 1973 it is indispensable, and most urgent from the point of view of energy policy, to find substitutes for the oil consumption of stationary consumers. This necessary substitution should also improve, especially in cases of dense population, the existing emission/immission structure of the polluting components in the air, which also includes SO_2. A further requirement is that the substitution be achieved with as low a burden on the national economy as possible. Among other measures, district heating will be increasingly useful in this context. District heating will have to be supplied more and more from combined heat and power processes, which allow energy to be saved, the environment to be protected and use to be made of coal as well as nuclear energy. Due to the concentration of substitution potential in densely-populated areas and to economic requirements (national and corporate), the combined heat and power processes will have to take place in large plants using condensation turbines which allow steam extraction and which generate district heating with little additional fuel consumption. The intention to use combined heat and power production as a programme has already been greatly developed. This intention is based especially on research studies covering the Federal Republic of Germany which point out the favorable effects of combined heat and power production with regard to ecology and the energy economy. The local realization, however, is not yet decided upon. This is mainly due to the fact that the supply of electricity and district heating and the environmental aspects are not yet seen, or cannot yet sufficiently be seen, from the same viewpoint.

7716 (CONF-8111123—) **District heating and the possible contribution of nuclear power.** (Schweizerische Vereinigung fuer Atomenergie, Bern). 1981. 120p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE83900218.

From Information meeting on district heating and the possible contribution of nuclear energy; Bern, Switzerland (16 Nov 1981).

Presented are 15 lectures held at the meeting dealing with the problems of district heating with a view to economy and engineering. For all lectures published in this report individual abstracts are given.

2910 Conservation

REFER ALSO TO CITATION(S) 7704, 7705, 7706, 7788, 7798, 7799, 7801, 7820, 7822, 7835

7717 (CONF-810140—) **Community energy planning: the winter meeting of the Tennessee Chapter American Planning Association.** Easley, G.; Blasius, W. (eds.). (American Planning Association, Knoxville, TN. Knoxville Area Section). Feb 1981. 93p. NTIS (US Sales Only). Order Number DE83900066.

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

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This workshop was designed to acquaint participants with games and short conferences for use in small communities to encourage energy conservation in the residential sector. Individual papers are included. (PSB)

7718 (CONF-810140—, pp 40-56) **Present practices in the use of local land use and fiscal programs to promote energy conservation.** Cagle, J. (Upper Savannah CDG, Greenwood, SC). Feb 1981. NTIS (US Sales Only).

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

The author reviews information on land use and discusses fiscal tools for use in implanting energy activities. Zoning, subdivision, and taxation were innovations recommended for use in achieving energy objectives.

7719 (CONF-810140—, pp 57-64) **Energy education project.** Adams, J. (Univ. of Tennessee, Knoxville). Feb 1981. NTIS (US Sales Only).

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

Views are presented concerning the involvement of schools in any successful community energy management program. A suggested outline for energy education curricula is projected. (PSB)

7720 (CONF-810140—, pp 65-67) **TVA community energy programs.** Crutchfield, B.C. (Tennessee Valley Authority, Knoxville, TN). Feb 1981. NTIS (US Sales Only).

From Community energy planning conference; Gatlinburg, TN, USA (29 Jan 1981).

This paper discussed TVA's community energy management program which is designed to demonstrate community models that can be adapted by other communities and which provide direct technical assistance to the commercial, industrial, agricultural and governmental sectors of the region. The model addresses energy related problems and suggests options for reduction of energy use through efficiency or through conversion to alternative energy sources. (PSB)

7721 (IIUG—81-13) Consumers and energy conservation. Gaskell, G.; Piks, R. (Wissenschaftszentrum, Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1981. 18p. Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany, F.R.

It is often assumed that domestic energy conservation will be achieved by technical innovation and the use of the price mechanism and if these fail, legislation is the only solution. This paper argues that policies must be developed on the basis of a greater understanding of the consumer perspective. The concept of 'energy literacy,' a typology of consumers concerning energy related cognitions and behaviour, is described and research reported which suggests that there are important personal characteristics which act as potential obstacles to energy conservation in the home. A field experiment involving 160 households is described in which substantial savings in household energy consumption were achieved by employing strategies designed to raise levels of energy literacy. The implications for policy are discussed. It is concluded that home energy audits have considerable potential but consumption feedback on its own is of limited value.

7722 Energy conservation: the post-embargo record. Reister, D.B. (Oak Ridge Associated Universities, TN). *Energy (Oxford);* 7: No. 5, 403-411(May 1982).

The best measure of energy conservation is a change in the ratio of energy demand to GNP. In the last decade, the ratio decreased by 16%. A simple model has been developed to forecast energy demand as a function of real energy price. The model can successfully backcast the post-embargo period. The long-run price elasticity of the model is unexpectedly large. The model forecasts that the ratio of energy demand to GNP will decline by an additional 34% based on current energy prices. 9 refs.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 7261, 7699, 7700, 7711, 7712, 7722, 7737, 7794

7723 (BMFT-FB-T—82-076) Study on the possibilities of more rational use of energy in the sector of trade and commerce. Pt. 1. Ebersbach, K.F.; Fischer, A.; Layer, G.; Steinberger, W.; Wegner, M.; Wiesner, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 146p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750728.

The objective of the study completed in July 1980 was the acquisition and analysis of energy demand in the sector of trade and commerce, and presentation of measures to improve the structure of energy demand. Therefore in several typical firms like hotels, office buildings, locksmith's shops, motor vehicle repair shops, butcher's shops, laundries and bakeries detailed surveys of energy consumption were done and included into a statistic evaluation. The study shows for the examined firms an analysis of, a) the development of the energy supply, b) the technology of energy application, c) the final energy demand broken down into demand for light, power, space heating and process heat as well as the demand for cooling, d) the daily and annual load curve of energy consumption and its dependence on various parameters, e) measures to improve the structure of energy demand. The detailed measurement points out negligences in the surveyed firms and shows some possibilities for likely energy savings. In addition, standard values for specific energy consumption could be obtained.

7724 (BMFT-FB-T—82-077) Study on the possibilities of more rational use of energy in the sector of trade and commerce. Pt. 2. Ebersbach, K.F.; Fischer, A.; Layer, G.; Steinberger, W.; Wegner, M.; Wiesner, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1982. 175p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE82750726.

The objective of the study completed in July 1980 was the acquisition and analysis of energy demand in the sector of trade and commerce, and presentation of measures to improve the structure of energy demand. Therefore in several typical firms like hotels, office buildings, locksmith's shops, motor vehicle repair shops, butcher's shops, laundries and bakeries detailed surveys of energy consumption were done and included into a statistic evaluation. The study shows for the examined firms an analysis of a) the development of the energy supply, b) the technology of energy application, c) the final energy demand broken down into demand for light, power, space heating and process heat as well as the demand for cooling d) the daily and annual load curve of energy consumption and its dependence on various parameters, e) measures to improve the structure of energy demand. The detailed measurement points out negligences in the surveyed firms and shows some possibilities for likely energy savings. In addition, standard values for specific energy consumption could be obtained.

7725 (CONF-7811206—) Energy supply and development planning of communities. (Deutscher Verband fuer Wohnungswesen, Staedtebau und Raumplanung e.V., Bonn (Germany, F.R.)). [nd]. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82906260.

From Energy supply and development planning of communities meeting; Koeln, F.R. Germany (30 Nov 1978).

Three reports are presented which have been held during an experts session of the German Association for Housing, City Construction and Area Planning in Cologne on November 30, 1978. The reports discuss the energy supply and the development planning of communities in view of long-term planing necessities, aplied economic needs and legal aspects. The annex shows the attitude of the association towards the integrated energy and urban development policy.

7726 (NP—2906257) Heat 2000. (Informationszentrale der Elektrizitaetswirtschaft e.V. (IZE), Bonn (Germany, F.R.)). Oct 1980. 21p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906257.

Heat 2000 is a contribution made by the German power industry to the present energy discussion which mainly refers to the long-term guaranteering of the energy supply in our country. A discussion which is significantly marked by the necessity of reducing the dependence on the mineral oil with its steadily decreasing availability and steadily increasing prices. The efforts made to reduce this dependence will have to concentrate on the field of heat supply and require more from all energy sources which are seen as alternatives of petroleum. This is also valid for power. The electricity supply companies do not present the following results with the intention of advertising or establishing energy-political demands. Thinking of their responsibility for the future they deem it necessary to inform and precondition substituting petroleum power in the heat supply. This presentation is an average approach pertaining to the Federal Republic of Germany. Regional peculiarities could not be paid special attention.

7727 (NP—2906258) Energy supply perspectives. (Deutsche Shell A.G., Hamburg (Germany, F.R.)). Oct 1980. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906258.

Following a few general remarks on the development of the world energy consumption, the demand and supply development of the individual energy carriers, mineral oil, natural gas, coal, nuclear energy and newer energy sources are investigated and clearly illustrated by a series of graphs. The possibilities for improved energy utilization is discussed generally. Finally, possibilities for future energy suply until year 2000 are outlined.

7728 (NP—2906259) Energy policy and the world energy situation. (VEBA A.G., Duesseldorf (Germany, F.R.)). [nd]. 19p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906259.

Data on world energy consumption and energy demand are presented in tables and some graphical illustrations for the period until the year 2000 or 2020.

7729 (PB—82-209420) The potential for converting California's industrial boilers to coal: an economic and environmental analysis. Final report. Egan, T. (California Univ., Davis (USA)). Nov 1980. 588p. NTIS, PC A25/MF A01.

This report discusses the effect of curtailed natural gas supplies on California's industrial steam boiler plants, and whether those plants could economically burn coal instead. A linear programming model is developed which assumes a choice of fuels and fuel-using equipment including coal/oil slurry, natural gas, residual oil, LPG, distillate oil, medium Btu coal gas, conventional coal boilers with pollution control, and fluidized bed boilers. Costs are minimized within the constraint of alternate air quality regulatory schemes, and a shadow price for nitrogen oxide emissions is derived. Extensive appendices examine fuel supply for California, present costs and operating data for the technologies listed above, inventory California's steam boilers, and discuss air quality and fuel use regulations.

7730 **(PB—82-212465) California energy futures: a presentation made to the california energy commission. Final report.** (SRI International, Menlo Park, CA (USA)). Nov 1980. 60p. NTIS, PC A04/MF A01.

Various long-term energy futures for California were studied. This study analyzes types of changes in people's consumption habits and living patterns that occurred in the 1970's, and then projects the energy consequences of those trends.

7731 **Data on the development of the West German power industry in 1980.** Bonn, Germany, F.R.; Bundesministerium fuer Wirtschaft (1981). 60p. (In German).

After a general review of the national and international energy situation and some general remarks concerning the supply of the most important energy sources in the Federal Republic of Germany, detailed figures of energy production, consumption, and trade are presented in tabular- and graphical form in comparison with past years, help to make trends clearer.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 6924, 7040, 7715, 7725, 7743, 7757, 7833, 7857, 7858, 7859

7732 (DOE/CS/24312—2, pp 5p, Section III, Paper B3) **Opening remarks: Portland, Oregon workshop.** Combs, B.J. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

The benefits of Section 210 of PURPA (Public Utility Regulatory Policies Act of 1978) and its implementation are reviewed briefly. Current litigation is described concerning PURPA as well as progress in a number of states to encourage cogeneration and power production. Feasibility studies are reviewed. Pricing based on avoided costs and the various factors involved are described. Some specific contracts are cited for investor-owned utilities and the implementation of PURPA by a federal power marketing agency (Bonneville Power Administration) is discussed. Contract terms, conservation of energy, generation of electricity from municipal waste, and public involvement are all considered. (MJJ)

7733 (DOE/CS/24312—2, pp 17p, Section III, Paper B4) **California's response to PURPA.** Mattson, B.W. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

California's activities in the area of cogeneration, small power production, and the Public Utility Regulatory Policies Act (PURPA) are reviewed from the pre-PURPA era (1976) to the present time. Actions by the California Public Utilities Commission and the Cogeneration Task Force (formed in early 1980) are described. The response, by the State of California, to PURPA, is described in detail. Emphasis was on insuring that the California laws are consistent with federal regulations. Rulemaking, particularly with regard to costs and payment rates for deliveries of electric energy are discussed as well as the problems encountered. Negotiations with energy suppliers, pre-approval of nonstandard contracts, and types of projects considered are described. It is concluded that considerable progress has been made in California with avoided cost prices now available, projects currently being developed, and hundreds of potential megawatts being discussed. An appendix includes information for specific utilities. (MJJ)

7734 (DOE/CS/24312—2, pp 2p, Section III, Paper C1) **PURPA from a utility viewpoint.** Seelke, J.L. Jr. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

The point of view of the utility industry in Florida is presented, particularly with regard to the Public Utility Regulatory Policies Act (PURPA) and its implementation. Sources of energy used by the Florida Power and Light Company (FPL) are reviewed briefly. It is pointed out that concern has not been with PURPA, but with its implementation by the Federal Energy Regulatory Commission (FERC) and the requirement of full avoided cost for power purchased from qualifying facilities and its implementation. Sources of energy used by the Florida Power and Light Company (FPL) are reviewed briefly. It is pointed out that concern has not been with PURPA, but with its implementation by the Federal Energy Regulatory Commission (FERC) and the requirement of full avoided cost for power purchased from qualifying facilities. PURPA induced power is discussed as well as the possibility that the FERC has overstepped the requirements of the law. The environmental assessment by the FERC of sections 201 and 210 of PURPA is described. The current status of FPL concerning rates for purchase of power is summarized. (MJJ)

7735 (DOE/CS/24312—2, pp 17p, Section IV, Paper B) **Cities as energy producers: a municipal perspective on energy recovery from waste.** Liss, G.B. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Problems of urban areas are discussed with emphasis on energy costs and the need to develop new economical energy sources and at the same to deal with solid waste disposal. Waste-to-energy and materials recovery facilities are described with Nashville, Tennessee and Akron, Ohio serving as prime examples. Characteristics sought by cities (Conference of Mayors, 1980) for an energy market and resource recovery project are: (1) Market stability and security; (2) Favorable pricing and financing; (3) Critical demand for energy; (4) Match of supply and demand; and (5) Compatible Reliability Goals. The importance of cogeneration is discussed and the following are cited as important for the combination of utility and industrial energy markets: (1) Reduced risk; (2) Financing and project revenues; and (3) Reliability of Service. The role and importance of the Public Utility Regulatory Policies Act (PURPA) in the overall picture is discussed and the experience of the Pacific Gas and Electric Company is cited. (MJJ)

7736 **Energy programme of the Federal Government.** Bonn, Germany, F.R.; Bundesministerium fuer Wirtschaft (1981). 96p. (In German).

After some basic remarks on energy supply as an economic and political challenge the German energy policy of the individual sectors is explained and corroborated by corresponding data. The appendix gives a new pre-assessment of the energy supply of the F.R. of Germany until the year 1995. Some additional graphs and tables contribute to a clear survey of this development. The programme contains a new confession on the promotion of nuclear energy and on the continuation of the recent energy policy in the fields of natural gas, coal and petroleum as well as some suggestions on the demand-oriented development of district heat and of renewable energies.

7737 **Possibilities of substituting mineral oil products in the Land Baden-Wuerttemberg.** Dolinski, U.; Labahn, K.D. Berlin, Germany, F.R.; Deutsches Inst. fuer Wirtschaftsforschung (1979). 149p. (In German).

The target given in the energy programme of Baden-Wuerttemberg in the year 1975, to lower the share of mineral oil products in this Federal State to less than 50%, can be realized. As a consequence of the structure of heating plants in industry as well as in households and, for other consumers and power plants, 5.7 million t coal equivalents of petroleum are to be substituted within one year. Thus the share of petroleum - compared to the values estimated in the status-quo prognosis - would be lowered to even less than 45%. The energy sources required for substitution are mainly available in the form of the energy sources natural gas and pit-coal, and, in the long term, in the form of 'new energy sources'. But since the prices

of energy sources finally decide whether the consumers are prepared for substituting their petroleum or not in a competitive economic system, and the price relations among the energy sources are not likely to change - even if there are further price increases - the realization of the objective can hardly be expected without supporting measures from energy policy. The investigation showed that the most efficient measures would be also the most dirigistic ones, however, they cannot be recommended from the point of view of a policy of order. At last there are - apart from the enlightenment - the monetary measures which are able to change the corner data of the competitive situation among the energy sources with the desired substitution effect, but which do not affect the individual freedom of decision.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 6922, 6923, 6924, 6941, 6944, 6944, 6948, 8885

7738 (NP—3900291) Michigan's oil and gas fields, 1980. Annual statistical summary 34. Bricker, D.M.; Elowski, R.C.; Reszka, C.R.; Milstein, R.L. (comps.). (Michigan Dept. of Natural Resources, Lansing (USA). Geological Survey Div.). 1982. 52p. Information Services Center, Dept. of Natural Resources, Box 30028, Lansing, MI 48909.

Portions of document are illegible.

This issue contains a statistical summary of information on oil and gas fields in Michigan. The data are derived mainly from the oil and gas section, Geological Survey Division, Department of Natural Resources. Information is presented on exploratory wells, development wells, gas storage wells, LPG storage wells, service wells, well completions, imports and exports, and drilling permits. The names of the fields are tabulated with production data for each included. Cumulative oil production data by geologic system and formation are presented. Data on State oil and gas revenues from 1927 to 1980 are also included. (DMC)

7739 Peat as a source of energy: an overview. Rader, A.M. (Minnesota Gas Co., Minneapolis). pp 19-25 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The history and current use of peat as an energy source are summarized in this paper. Research and development programs in the USA and Canada are briefly reviewed. (DMC)

7740 Department of Energy peat program. Kopstein, M.J. (Dept. of Energy, Washington, DC). pp 263-271 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The Department of Energy (DOE) has generated a comprehensive and broad program for developing a technology, through the pilot plant stage, for converting peat to substitute natural gas in an economical and environmentally acceptable manner. The program is comprised of six project elements: (1) gasification development; (2) dewatering; (3) resource estimation; (4) environmental impact assessment; (5) socioeconomic impact assessment; and (6) harvesting. The specific tasks will be performed in parallel until the middle of fiscal year 1982. At that time, a decision will be made concerning the direction and level of support for future DOE involvement in peat gasification. It is important to note that most of the studies being performed for DOE in the last five project areas must necessarily precede the utilization of peat for any energy application. In other words, the same technical, economic, and environmental problems and issues that are being addressed in this program must be considered for direct combustion, liquefaction, briquetting, and pelletization. DOE is encouraging the participation of states having an interest in developing peat as an energy source in the Resource Estimation project area. The objective is to obtain a precise estimate of the amount and location of fuel-grade peat that may be harvested in an environmentally acceptable manner in the United States. Joint DOE/state projects are being commenced with Maine, Minnesota, Michigan, Alaska, North Carolina, and South Carolina. Radian Corporation and UOP/SDC are performing Phase I of the Environmental and Socioeconomic Impact Assessments. Technical studies are being performed by IGT, Minnegasco, Dynatech, Rockwell, and UOP/SDC. Project descriptions are provided in the DOE Peat Prospectus.

7741 Utilization of Canadian peat as an alternative energy source. Tibbetts, T.E. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). pp 273-279 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assesement of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

In several European countries, including Russia, it has become economically attractive to utilize peat as a fuel for power generation, the production of metallurgical coke, the production of fuel briquettes for the domestic market, and low-Btu gas. While the economic base and the availability of energy supplies in Europe are much different from those in Canada, regional economics in Canada may warrant the development of peat as an alternative source of energy. Canadian peatlands cover several thousand square kilometers and have historically been considered wasteland. Now, with the increasing costs of other energy sources, it is apparent that fuel peat should be reevaluated as a potential energy resource. A nationwide inventory of peat deposits has been prepared, and resources have been evaluated for some of these areas where field surveys have been carried out. The Canada Department of Energy, Mines and Resources, through the Canada Centre for Mineral and Energy Technology (CANMET), has contracted out a multiphase investigation directed to the assessment of Canadian peat as an alternative fuel for power generation. The objectives of the investigation are to provide an overview of the potential of the Canadian peat resources to offer an alternative fuel for electric power generation, to assess the technology available to utilize the resources for power, and to translate international technology and conditions to the Canadian scene. This paper summarizes Canadian peat resources and several studies undertaken to evaluate the potential of a peat-fired steam-electric power station in Canada.

7742 Minnesota Peat Program. Malterer, T.J. (Minnesota Dept. of Natural Resources, Hibbing). pp 281-287 of Management assessment of peat as an energy resource. Executive conference proceedings. Chicago, IL; Institute of Gas Technology (1980).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

There is approximately 7.5 million acres of peat in Minnesota. This represents about half of the peat in the lower forty-eight states. Approximately 90% is Hemic type peat which is best for energy. The remaining 10% is better suited for agricultural, horticultural, and other purposes. The Minnesota Peat Program, under the direction of the Department of Natural Resources, is in the process of developing baseline information and alternative management policies on its peatlands. These alternative policies will be presented to the State Legislature which will select the most desirable policy. The Department of Natural Resources is pursuing a four-step policy development. The steps are: (1) acquainting the people with the peat issue; (2) identifying informational needs; (3) initiating studies to answer informational needs; and (4) evaluating study results in order to present the Minnesota Legislature with alternative management policies. Steps 1, 2, and 3 are nearly done. The studies initiated include hydrology, resource estimation, crop suitabilities, forestry, vegetation, horticulture, and energy. The studies are in various stages of completion. In 1981, the results of the studies, along with alternative management policies, will be presented to the State Legislature. At that time, the question of peat utilization for energy will be made.

2960 Electric Power

REFER ALSO TO CITATION(S) 7147, 7293, 7298, 7299, 7300, 7301, 7302, 7303, 7304, 7305, 7345, 7347, 7348, 7350, 7352

7743 (DOE/CS/24312—2, pp 4p, Section III, Paper C2) **Municipal looks at PURPA 201/210.** Newton, D.H. (Braintree Electric Light Dept., MA). Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

The history of electric power generation (starting in 1833) in the Braintree, Massachusetts area leading to the formation of the Braintree Electric Light Department is reviewed. Also reviewed are the results of a 1977 study for the installation and operation of a 1000 ton/day municipal solid waste facility designed to produce 20 MW of new generating capacity. This new facility and possible new sources, through the Public Utility Regulatory Policies Act (PURPA), are seen as a salvation to the municipal utility which is unable to operate economically due to high fuel and operating costs and lacks an adequate and affordable power supply after October 1984. Electric rates are discussed as well as requirements of the new planned facility. (MJJ)

7744 (DOE/PE/70009—1) **Public perceptions of future electric supply, utility financial conditions, and related issues.** (Planmetrics, Inc., New York (USA)). Nov 1982. Contract AC01-78PE70009. 142p. NTIS, PC A07/MF A01. Order Number DE83003672.

Portions of document are illegible. Printed copy available until stock is exhausted.

The results are presented of an in-depth study of public perceptions of electric utility financial conditions, future electric power supply and related issues which will affect US government planning and action to ensure future electric power supply at reasonable cost. Group interviews were held across the country, and the findings from these interviews were used to develop a questionaire for surveying a national probability sample. The major findings included that a majority of Americans: consider electricity as a right, not a product; don't worry about future electric supply nor the financial condition of utilities, but believe utilities have locked long-range planning; think that power rates are excessive and that Public Utility Commissions favor the utilities over the customers; support regional planning and generation and government-utility cooperation in research and planning; and are concerned about environmental quality and about nuclear power plant costs and safety. The policy implications of those opinions are discussed. (LCL)

7745 (EPRI-NP—2169-Vol.2) **Guide to generation-availability evaluations and decisions. Volume 2. Applications and implementation. Final report.** Crellin, G.L.; Smith, A.M. (Los Alamos Technical Associates, Inc., NM (USA)). Oct 1982. 392p. NTIS, PC A17/MF A01. Order Number DE83900516.

In two volumes, this guide to generation and availability evaluations and decisions provides a comprehensive manual on how to perform analyses and calculations, how to use and interpret results, and how to implement a program employing availability engineering and decision analysis principles. Volume 2 focuses on applications and implementations of the basic analysis methods and principles presented in Volume 1. Experience and results of availability programs are reviewed. The objectives, and the strategy for achieving the objectives, of an availability program are discussed. The major features and necessary elements of an availability program are detailed to show how and where the analysis methods are employed. The requirements for data and the sources of these data are also discussed. Numerous case study examples of the use of deterministic and probabilistic analyses within the context of availability program decisions are presented. These examples illustrate the application of availability engineering and decision analysis techniques, the interpretation of results, and the use of structured analyses to teach decisions.

7746 (NP—2750327) **Danish electricity supply 1980.** (Danske Elvaerkers Forening, Copenhagen). Apr 1981. 36p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750327.

The Danish Association of Electricity Supply Undertakings hereby issues the fifth volume of its statistical yearbook. By the means of brief text, figures, and tables the trend in the latest years of the electricity supply sector is elucidated, as well as the expected trend for the coming years. Information is given of electricity consumption and distribution together with production of electricity and of heat. In 1980 the amount of electric energy available for the consumers was 23.941 GWh. This is only 0,3% more than in 1979. In 1980 the heat production for district heating in power stations for combined heat and electricity production amounted to 30,757 TJ, which is 4,3% more than in 1979. The total fuel consumption of electricity and district heating in Danish power stations in 1980 was 263,700 TJ, which is 15.2% more than in 1979. Of the total fuel consumption coal covered 82% and oil the remaining 18% in 1980. This signifies a remarkable change in the fuel consumption pattern. In 1979 oil was the predominant fuel covering 77% of the consumption. The programme for conversion to coal is dealt with in a separate article. The installed capacity of the Danish power stations is 6618 MW. 99.5% of the production capacity is placed in 18 primary power stations and 95.5% of the capacity is based on steam power. In 1980 the average electricity consumption per inhabitant was 4250 kWh or 0,3% more than in the previous year. Extensions comprising 1572 MW electricity generating capacity are under construction or have been decided to be put in operation until 1986.

7747 (NP—3900244) **Business report 1980.** (Steirische Wasserkraft- und Elektrizitaets-A.G. (STEWEAG), Graz (Austria)). 1980. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83900244.

The annual report 1980 of the Steirische Wasserkraft- und Elektrizitaets-AG, Graz, (water power and electricity company) deals, in the report of the board of directors, with general matters, energy economy, operational course, new buildings and their maintenance, personnel questions, financing, and explanations concerning the annual statement of accounts of the company. A report of the Supervisory board is followed by balances, profit and loss calculations, a balance comparison with 1979 and a survey of the investment situation.

7748 (NP—3900245) **Regional energy supply 1980-1981.** (Arbeitsgemeinschaft Regionaler Energieversorgungs-Unternehmen (ARE) e.V., Hannover (Germany, F.R.)). Apr 1982. 205p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE83900245.

After some explanations concerning the regional energy supply within the framework of the general economical development, a general summary of the activities of the Work Team of the Regional Energy Supply Companies (ARE) is given for the time since the annual meeting in 1980. Special attention is paid to energy policy, energy economy laws, energy pricing laws, the practical handling of the general supply conditions and measures of crisis prevention. Finally, the organisations of the ARE are reported on.

7749 (TVA/OP/ECR—82/81) **Monthly load data report.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Conservation and Rates). 1981. 25p. NTIS, PC A02/MF A01. Order Number DE83900170.

The megawatt power demand on the TVA system for each month from October 1980 through September 1981 is tabulated with information on customer class, class peak load and system peak load. A graph of the hourly power demand on the peak load day of each month is included. (LCL)

7750 **Oil backout and the price of electricity.** Ford, A.; Polyzou, A. (Los Alamos National Lab., NM). *Energy (Oxford);* 7: No. 5, 429-448(May 1982).

The authors investigate the new economics of oil backout. According to the new economics, electric-utility companies with heavy dependence on oil-fired plants should proceed rapidly with construction of new coal or nuclear plants in order to hasten the phase-out of oil consumption. The new economics support investments in new capacity, even though the investments may push industry reserve margins well above the 20% safety margin usually thought to be sufficient for reliable service. It is argued that the

fuel-cost savings from reduced operation of the older oil-fired plants will exceed the extra construction costs of the new coal and nuclear plants, and that electricity rates will be reduced. To test this claim, the authors examine the probable effect on electricity rates of an overbuilding strategy for several different types of utility companies. A computer simulation model is used to project the price of electricity that a hypothetical, oil-dependent, investor-owned, electric utility would have to charge in order to recover its annual costs and earn the allowed return on investment. The final results take the form of penalty/cost curves showing the values of the oil backout cost ratio for which overbuilding would lead to higher/lower rates. 22 refs.

7751 **Impact of price variations on the consumption of electrical energy.** Uri, N.D. (DOE, Washington, DC). *Applied Energy;* **10**: No. 3, 177-188(Mar 1982).

The paper discusses the impact of changing prices on the sectoral demand for electrical energy in the United States. By using a cross-correlation test for unidirectional causality, it is shown that in the cases of residential, commercial, and industrial demands, the quantity consumed is affected by changing prices. 16 refs.

7752 **Statistical analysis of U.S. power plant capacity factors through 1979.** Easterling, R.G. (Sandia National Lab., Albuquerque, NM). *Energy (Oxford);* 7: No. 3, 253-258(Mar 1982).

Power-plant capacity factors have been statistically analyzed in order to identify trends or other sources of variation in these data. The following U.S. power plants are covered in this analysis: (a) nuclear power plants with rated capacity (as measured by the maximum generator nameplate rating - MGN) in excess of 400 MW (megawatts-electric) and (b) coal-fired power plants rated as supercritical (boiler pressure in excess of 3208 psi) in excess of 400 MW (MGN). The author discusses some of the issues involved in a statistical analysis along with the results. The main findings are that capacity factors tend to increase in the first few years of operation and that small PWRs (between 400 and 600 MW) have had larger capacity factors than did BWRs or large PWRs. 8 refs.

7753 **Analytic model for determining the long term amount of nuclear capacity in Canada: an explanation of the multi region and single region model results.** Rogers, J.S. (Univ. of Toronto, Ontario); Choudhury, S.K. pp 72-76 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This paper first shows the degree to which the estimates of the long term amount of nuclear generation capacity in Canada differ between a single and a multi region model. We then construct an analytic model from whose optimal solution we derive a closed form expression for the difference between the two computational model estimates. The properties of the optimal solution to the analytic model are then used to illustrate the degree to which the results from the large model depend (in the neighborhood of the optimum) on its major parameters. Numerical results from each type of model demonstrate the validity of the analytic result.

7754 **Modeling the electric utility impact of solar electric technologies.** Day, J.T.; Malone, M.J.; Powell, R.W. (Westinghouse Electric Corp, Pittsburgh, PA). pp 104-105 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

Due to the diurnal nature of sunshine, the uncertainty of weather, and the occasional implementation of dedicated storage, solar electric technologies present a unique challenge to the electric utility planner. Extensions are required to conventional utility models to capture the peculiar operating characteristics of solar plants, and in particular their impact upon the bulk electrical supply system's reliable load carrying capability. This paper discusses model extensions implemented to assist in determining the potential value and reliability impact of solar plants.

7755 **Residential sales forecasting with parabolic regression.** Wilson, P.R. (Federal Univ. of Rio G. do Sul, Brazil). pp 508-512 of Proceedings of the seventh power-systems computation conference. Laughton, M.A. (ed.). Guildford, England; Westbury House (1981).

From 7. power systems computation conference; Lausanne, Switzerland (12 Jul 1981).

This study presents a real case of forecasting of the residential class of customers of a large Brazilian utility company. The objective was to determine the yearly forecast values of the variables number of residential customers and energy consumption per residential customer whose product results in the yearly forecasted values of the residential energy consumption. This method calls for reduced quantity of historical data that as we know are difficult of obtaining in a developing country. Besides, the required data such as total state population, urban state population, number of state residential customers are easy to quantify and to relate with the residential energy consumption.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 7722, 7751

7756 **Energy flowsheet 1980 of the Federal Republic of Germany.** Essen, Germany, F.R.; Rheinisch-Westfaelisches Elektrizitaetswerk A.G. (1980). 5p. (In German).

The energy flowsheet has been published twice, in petajoule (PJ) and in million tonnes of coal equivalent. The flowsheet gives vertical energy lines whose thickness is proportional to the amount of energy consumed. The lines are divided into the following sections: Domestic energy production; energy sectors (preparation and conversion); end use energy consumption and consumption sectors. This makes it easy to find out which energy sources and how much of them are used to what purpose. In the section on consumption sectors, the energy consumed per year is divided up into 'energy used' and 'energy lost'. Estimates are given for these values.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 7091, 7124, 7125, 7126, 7138, 7139, 7140, 7147, 7170, 7246, 7732, 7733, 7734, 7735, 7833, 7856, 7860, 7861, 7869, 7873, 7874, 7892, 8355, 8356, 8357, 8358, 8902

7757 (DOE/CS/24312—2, pp 9p, Section II) **Federal incentives for cogeneration and small power production.** Ain, R.D. (Van Ness, Feldman and Sutcliffe, Washington, DC). Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Recent federal incentives for the encouragement of cogeneration and small power production are discussed with emphasis on the Public Utility Regulatory Policies Act (PURPA). A number of specific issues are described (e.g. qualification rules and full vs. less than avoided costs). Two main points are made: (1) As interpreted by the Federal Energy Regulatory Commission, PURPA leaves a great deal of discretion to the states (states are responsible for arriving at the best full avoided cost); and (2) PURPA is not a rigid piece of legislation but leaves room for negotiation of a mutually advantageous arrangement. Requirements and options of state regulatory authorities with regard to PURPA are treated as well as efficiency standards, arbitrage possibilities, interconnection costs, and limitations. (MJJ)

7758 (DOE/CS/24312—2, pp 27 p, Section III, Paper C3) **Energy recovery from waste: Pacific Gas and Electric Company's approach under PURPA.** Meyer, J.G. (Pacific Gas and Electric Co., San Francisco, CA). Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Energy sources of Pacific Gas and Electric Company, serving northern and central California, are reviewed. Activities to obtain energy from waste materials (e.g. garbage from the San Francisco area) are discussed as well as the interests of the California Public Utiilties Commission in cogeneration, resource recovery, and renewable sources. Examples of agreements applicable to pur-

chase of power are illustrated and rate structures are described for on-peak, partial peak, and off-peak times as well as monthly variations. Interconnection guidelines to ensure safe parallel operation of cogeneration facilities are discussed as well as programs to assist industry in evaluating and developing projects which include solid waste (9 projects), biomass, cogeneration, wind, geothermal and solar energy. The influence of the Public Utility Regulatory Policies Act (PURPA) on the rate structure of California public utilities is mentioned briefly. (MJJ)

7759 **Rural energy and development: a strategic planning analysis.** Ganapathy, R.S. (Indian Inst. of Management, Ahmedabad). pp 13-39 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Rural energy problems are analyzed in the broad development context. Approaches to rural energy planning are discussed, and policy options to deal with the rural energy crisis are developed. Particular reference to renewable energy sources is made. (RJC)

7760 **Rural development in India through science, technology, and new science policy initiatives.** Tilak, B.D. (Indian Inst. of Education, Pune). pp 77-90 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The Council of Scientific and Industrial Research (CSIR) has instituted a number of development plans for rural areas of India through innovative use of science and technology. Projects in the areas of water management, agriculture and forestry, improvements in homes, government buildings, clothing, health, and hygiene, and small industry are described. To implement these plans, the Rural Development Center (RDC) was established in 1978. The role of the RDC is described and some of their accomplishements are summarized. (RJC)

7761 **Appropriate energy technologies, agriculture, and national planning.** Pryor, C.A. (Center for Integrative Development, New York, NY). pp 153-157 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper addresses the conflict between various perspectives on energy and agriculture which may affect the diffusion of appropriate technology in developing countries. Discussed are some of the underlying issues, renewable energy placed in its national and international context, and how institutional constraints may limit the use of appropriate technologies in the developing world. Nine concepts which affect policy makers and analysts are presented. (RJC)

7762 **Financing renewable energy projects for rural development.** Hoffmann, R.T. (International Inst. of Environment and Development, Washington, DC). pp 158-161 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Issues involved in financing renewable energy projects in developing countries are discussed. Three revenue sources include: aid agency programs, private entrepreneurs, and local accumulation of cash resources. Energy planners are cautioned to be aware of competition for the available money. (RJC)

7763 **Choosing renewable energy technologies to meet village-level basic needs: a bottom-up approach.** Ashworth, J.H. (Solar Energy Research Inst., Golden, CO). pp 162-178 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The author states that the development community must focus its efforts in the next five years on the location of four missing components necessary to the adaptation, adoption, and diffusion of renewable energy systems. The four components are: reliable information on the performance and problems of renewable energy systems in the field; practical analytic tools for field personnel; careful cost/benefit analysis of installed systems; and information on the impacts of the conscious involvement of local entrepreneurs, craftsmen, and businessmen. Some thoughts are given about the advantages of such a needs-driven or bottom-up planning mechanism over a technology-driven demonstration program. (RJC)

7764 **Considerations in the development of a renewable rural energy program in developing countries.** Carella, V. (Energy Projects Information Consultants, Costa Mesa, CA). pp 209-220 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

After a nation has made the commitment to utilize renewable energy technologies in its rural areas, there are several distinct considerations which should be taken into account. These considerations are discussed for the policy stage, planning stage, finance, choice of technologies, land use and social implications, implementation stage, and the evaluation stage. (RJC)

7765 **Exchange paradigm: possibilities and limits for technology transfer in the 1980s.** Brams, P.C. (Rice Univ., Denver, CO). pp 223-233 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Technology transfer from more technologically advanced countries to less developed countries may be viewed generally as an evolution in three sequential stages - the extension paradigm of the 1960s, the delivery paradigm of the 1970s, and the exchange paradigm which is emerging for the 1980s. Each of these paradigms reflects a distinct orientation to technology transfer. The evolution of the transfer paradigm of exchange are traced in the first sections of this paper. The centerpiece, however, appear in the epilogue where a pivotal issue is considered. Will serious political and economic global problems - e.g., energy constraints, inflation, psychological and economic depression, and growing First World conservation - preclude the adoption of exchange as the predominant transfer model for the 1980s. How will the enterprise of technology transfer be affected by mounting global insecurity. These questions are examined. (RJC)

7766 **VITA renewable energy program for rural and urban poor in developing countries.** Gross, W.A. (Volunteers in Technical Assistance, Mt. Rainier, MD). pp 234-238 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper describes the Volunteers in Technical Assistance (VITA) five-year, three-part Renewable Energy Program (REP). Discussed are: elements of the REP, program implementation fund, and the program staff. VITA provides technical responses to in-

quiries, supports development of information and resources exchanges, and provides small grants for indigenous projects. (RJC)

7767 **Appropriate technology in research supported by the International Development Research Centre, Ottawa, Ontario.** Smart, C. (International Development Research Centre, Ontario, Ottawa). pp 239-244 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The International Development Research Centre (IDRC) sponsors research in four areas: agriculture, food and nutrition sciences; health science; information sciences; and social sciences. Rural energy and technology projects have been sponsored in all four areas. Research programs in social sciences dealing with renewable energy source development in developing countries are discussed.

7768 **Development planning and appropriate technology: a dilemma and a proposal.** Ellis, G. (Univ. of Denver, CO). pp 265-283 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Three approaches to rural development planning are described in this report: the analysis of the problem; implementation; and treating the method as a problem. There are defects in the present system of project paper preparation and project planning related to viability and the choice of technology. The author evaluates several project planning strategies including the holistic blueprint approach and cost-benefit studies. The present planning methods lead to justifying projects rather than planning them. The proposed analytical evaluation system should have the following components: technologies information; local information; analysis; and information output. Such a system could accomplish these major objectives: (1) it would force planners to consider more appropriate technologies; (2) the present two year lag time from proposal to funding could be eliminated; (3) evaluation studies could be effectively incorporated; (4) emphasis would be on project performance and implementation; and (5) local planners would develop independence and be able to exercise initiative. (RJC)

7769 **Some considerations concerning the application of biogas technology: a sociocultural view.** Warpeha, P.R.; Goldman, L.C. (Farallones Inst. Rural Center, Occidental, CA). pp 293-307 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Biogas technology has the potential to be an appropriate application of an alternative and renewable source of energy in developing countries. It is a source of fertilizer and fuel and holds great promise for improved health and environmental sanitation. The development of this technology in India, China, and Ecuador is described. Some of the socio-economic constraints for implementing this are discussed. (RJC)

7770 **Appropriate rural technology.** Soyemi, T.O. (NAAAT, Lagos, Nigeria). pp 313-316 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper points out the need for adequate training of personnel for the implementation and success of appropriate technology. With proper training problems which arise from the use of technology can be solved at the local level using locally available materials. (RJC)

7771 **Utilization of renewable energies in rural areas of China.** Lin, H.; Xu, Z.; Sun, W. (State of Scientific and Technology Commission of China, Beijing). pp 361-366 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

In addition to increasing commercial energy supplies in rural areas, great effort is being made to develop indigenous energies, especially the renewable energies in China. The present state of renewable energy utilization in rural areas is discussed. Utilization of biogas, mini-hydro power, wind energy, and solar energy are described. (RJC)

7772 **Small-scale energy technologies in the developing world: the western Pacific experience.** Case, C.W.; Schaller, D.A. (Solar Energy Research Inst., Golden, CO). pp 377-384 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper relates some experiences in developing alternate energy projects in some US territories in the Pacific. Case studies highlighted are: a solar dryer project in Romanum in Truk State within the Federated States of Micronesia (FSM); a solar dryer/oven and a woodburning stove for cooking projects in the state of Yap; a small biogas unit, a solar water-distilling systems, a wind water-pumping system, two solar hot water systems, and a solar-powered refrigerator projects in the northern Mariana Islands; a biogas project in American Samoa; and a solar hot water collector demonstration and solar air conditioners and refrigerators projects in Guam. (RJC)

7773 **Fuelwood and rural energy needs in Kenya: strategies for supply enhancement and demand mitigation.** Weiner, D.; Shakow, D.; O'Keefe, P. (Clark Univ., Worchester, MA). pp 385-397 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper discusses the Kenyan energy situation, fuelwood in Kenya, and the prospects for the enhancement of rural energy supplies other than wood. Also included is a description of a project that has just begun in Kenya, where the primary objective is the development of a comprehensive national agroforestry program. (RJC)

7774 **Rural Egypt's renewable energy potential: a technical and economic assessment.** Connelly, J. (MITRE Corp., Bedford, MA); Leigh, J.; El Sawy, A.H.; Talib, A.; Fritz, J.J. pp 406-425 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper is an assessment of practical options for the use of alternate energy resources for rural and agricultural uses in Egypt. In the first part of the paper the Egyptian context is presented. The remaining sections are discussed of solar collectors for water and space heating for domestic and institutional applications, solar crop and food drying, solar flat plate collectors for refrigeration and cooling, photovoltaic collectors for remote applications,

wind energy conversion systems for water pumping, rural biogas digesters, and improved rural stoves. (RJC)

7775 **Renewable energy process and technology for African villages.** Lillywhite, M.; Lillywhite, L. (Domestic Technology Inst., Evergreen, CO). pp 426-438 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

AID-funded national renewable energy projects have been conducted in six African countries. In addition to project development activities, workshops and short-term training activities were conducted in Botswana, Lesotho, Swaziland, Kenya, the Sudan, and Somalia. These hands-on activities with village people produced the most valuable information about the adaptation of suitable technologies and for understanding traditional village energy use. This paper discusses the essential ingredients of a village-level renewable energy project which uses primarily low-cost passive solar technologies, the matching of basic village needs and solar technologies, and a summary of conclusions. Out of the project design activities came the development of a particular socio-technological implementation process which focuses on the energy related needs of rural poor villages. This process emphasizes the socially and cluturally sensitive aspects of this unique type of development work. The projects' components consist of a delicate balance between village survey-evaluation and feedback, technological development, training, and project management functions. These are discussed in this article. (RJC)

7776 **Energy independence starts in the topsoil.** Stanford, G. (Greenhills Center, Cedar Hill, TX). pp 441-451 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

A number of immediately applicable strategies are outlined which together can lead a presently uncommitted rural area of a developing country toward that attainable goal: a steady increase in their standards of living which is based on an integrated system of conservational agriculture and energy through enhanced production of luxury biomass. Topics discussed are: nitrofixing, photosynthesis, energy storage, respiration, climax ecosystem, luxury production, man, agriculture, time effects, the green revolution topsoil energy, chemical fertilizer, protein, the biofarm, profit and loss, agricultural valves of refuse, co-recovery of sewage and refuse, an agro-industrial economy, and refuse exchange for oil. The author summarized by stating that by focusing our attention on our topsoil, by increasing its carrying capacity, and by living within that carrying capacity, we can move steadily towards our goal and that energy independence starts in our topsoil. (RJC)

7777 **Planning for research and development in integrated resource recovery.** Gunnerson, C.G. (World Bank, Washington, DC). pp 527 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This short paper describes the preliminary planning that is underway for World Bank research and development in integrated resource recovery. The long term objectives of the program are to achieve replicable health, environmental, energy, employment and economic benefits through integrated resource recovery projects in developing countries. (RJC)

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

7778 **Comparison of analytical and experimental studies of the HPDE MHD generator performance.** El Derini, Z.; Doss, E.; Lenzo, C. (Argonne National Laboratory, Argonne, IL). *AIAA Paper;* No. 81-0029, vp(1981). (CONF-810106—).

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

The MHD generator performance of the High Performance Demonstration Experiment (HPDE) has been analyzed using the ANL quasi-three-dimensional computer model. Computations performed for the operating conditions of tests No. 10 and 14 indicate that, for both tests, the trends and magnitudes of the experimental data for various electrical and gasdynamic variables are in good agreement with the analytical predictions. The variation of the channel performance as a function of the channel wall temperature, surface roughness, load factor, and magnetic field strength is examined, and numerical examples are given. Performance maps, showing channel enthalpy extraction versus isentropic efficiency, are generated for range of magnetic field strengths, loading parameters, and electrode surface temperatures. A 'diagnostic data analysis' (DDA) procedure has been developed for further verification of the accuracy of the predictions of the quasi-three-dimensional model. In this procedure, the experimental data are used to compute the gasdynamic flow parameters and the boundary layer voltage drop characteristics in terms of average electrical conductivity and average electrical resistance. The results of this DDA procedure and those of the quasi-three-dimensional model are in good agreement.

7779 **Comparison of experimental results from the UTSI coal-fired MHD generator to theoretical predictions.** Lineberry, J.T. (Tennessee, University, Tullahoma, Tenn.); Galanga, F.L. (Argonne National Laboratory, Argonne, Ill.). *AIAA Paper;* No. 81-0031, vp(1981). (CONF-810106—). Contract AC02-79ET10815.

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

Experimental data collected from recent coal-fired MHD generator tests are compared to theoretical predictions. Three independent numerical models are employed for this comparison, a one-dimensional model, a two-dimensional model which includes modeling of the slag layer, and a quasi-three-dimensional model. Comparisons are made between measured gas dynamic and generator electrical performance parameters to those predicted by each method. These comparisons are drawn for a fixed set of generator operating conditions which include an experimentally inferred entrance temperature. The analyses illustrate the effects of flow field dimensionality on generator performance predictions. Discussions on the applications and limitations of each code are included along with suggestions for refinements to achieve an improved modeling of real MHD phenomena.

7780 **U-25B MHD generator performance.** Doss, E. (Argonne National Laboratory, Argonne, Ill.); Picologlou, B.F. (Southern Illinois University, Carbondale, Ill.). *AIAA Paper;* No. 81-0032, vp(1981). (CONF-810106—). Contract W-31-109-ENG-38.

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

The performance of the U-25B MHD generator is analyzed with theoretical predictive models developed at Argonne National Laboratory. Modifications and improvements of the computer codes, motivated from study of the experimental results, are outlined and discussed. The theoretical predictions are compared to experimental results and good agreement is found. Sensitivity studies involving a number of input parameters are used to identify those parameters that have a strong impact on generator performance.

7781 **Two-phase liquid-metal MHD generator experiments and pressure-gradient correlations.** Dunn, P.F.; Fabris, G.; Pierson, E.S.; Petrick, M. (Argonne National Laboratory, Argonne, IL). pp 145-155 of MHD-flows and turbulence. II. Branover, H.; Yakhot, A. Jerusalem, Israel; Israel Universities Press (1980).

Experimental results of single and two-phase liquid-metal MHD investigations using circular and rectangular test-section geometries are presented. Single-phase pressure gradient data for the circular geometry are compared with the existing MHD theory. The two-phase results for both geometries agree with a two-phase MHD correlation developed here. Tests were conducted in a 10-cm diameter circular stainless-steel pipe with sodium and nitrogen over the range of liquid mean velocities of 2-4.2 m/s, mixture qualities from zero to 0.0053, and magnetic flux densities from zero to 0.9 T, at 530-810 K.

7782 **Liquid metal MHD generators with shunt layer.** Lykoudis, P.S. (Argonne National Laboratory, Argonne, IL). pp 183-191 of MHD-flows and turbulence. II. Branover, H.; Yakhot, A. Jerusalem, Israel; Israel Universities Press (1980).

An analysis of the shunt layer in a liquid metal magnetohydrodynamic generator was performed in a closed form assuming a two-dimensional duct with a uniform two-phase core with walls wetted by liquid. An expression is derived for the generator efficiency as a function of the load factor using standard Hartmann layer approximations. The efficiency has the same expression with a uniform working fluid at an effective Hartmann number in terms of ratios of viscosity and electrical conductivity for the two-phase to the liquid phase value. It was concluded that the high Hartmann number at which generators operate the shunt layer does not significantly decrease generator efficiency.

3005 Fuel Cells

7783 **Method for producing a fuel cell manifold seal.** Grevstad, P.E.; Johnson, C.K.; Mientek, A.P. (to Dept. Of Energy). US Patent 4,337,571. 6 Jul 1982. Filed date 6 Nov 1979. vp.

PAT-APPL-091843.

A manifold-to-stack seal and sealing method for fuel cell stacks. This seal system solves the problem of maintaining a low leak rate manifold seal as the fuel cell stack undergoes compressive creep. The seal system eliminates the problem of the manifold-to-stack seal sliding against the rough stack surface as the stack becomes shorter because of cell creep, which relative motion destroys the seal. The seal system described herein utilizes a polymer seal frame firmly clamped between the manifold and the stack such that the seal frame moves with the stack. Thus , as the stack creeps, the seal frame creeps with it, and there is no sliding at the rough, tough to seal, stack-to-seal frame interface. Here the sliding is on a smooth easy to seal location between the seal frame and the manifold.

7784 **Effect of sulfur on the anodic H_2(Ni) electrode in fused Li_2CO_3-K_2CO_3 at 650°C.** Vogel, W.M.; Smith, S.W. (United Technol Corp, South Windsor, CT). *Journal of the Electrochemical Society;* **129**: No. 7, 1441-1445(Jul 1982).

Steady-state polarization curves for rotating Ni wires in Li/sub 2/CO/sub 3/-K/sub 2/CO/sub 3/ (62 m/o Li) at 650/degree/C are reported for H/sub 2/-containing gas of different H/sub 2/S contents. In the absence of sulfur, the diffusion-limiting currents are only slightly larger than the observed limiting currents. A reduction in the observed limiting currents by the presence of H/sub 2/S is interpreted as a decrease of the reaction-limiting current, i.e., as poisoning of the Tafel reaction. The sulfur effect levels off at P/sub H2S//P/sub H2/ approximately 10/sup -4/ which suggests that the sulfur coverage approaches a saturation value, and that a sulfur-saturated Ni surface retains a finite activity for H/sub 2/ oxidation. H/sub 2/S is not oxidized at a significant rate at potentials below that of Ni sulfide formation. An approximate rate equation for H/sub 2/ oxidation is derived for small sulfur coverages. This work is pertinent to fuel cells. 11 refs.

7785 **Alternate matrix material for molten carbonate fuel cell electrolyte structures.** Arendt, R.H. (GE, Schenectady, NY, USA). *Journal of the Electrochemical Society;* **129**: No. 5, 979-983(May 1982).

The preparation and physicochemical characteristics of SrTiO/sub 3/ crystallites suitable for use as the matrix for liquid alkali carbonates in fuel cells are presented. The preparation utilizes a fugitive molten alkali chloride solvent to effect product formation. The product, following separation from the reaction medium, is composed of submicron, relatively uniformly shaped and sized, monodispersed crystallites. Data are presented on the utilization of this material in both hot-pressed and impregnation fabricated electrolyte structures. Data from the preliminary fuel cell evaluation of such structures are also presented. 14 refs.

7786 **Influence of annealing on the electrical conductivity of polycrystalline ZrO/sub 2/+8 wt% Y/sub 2/O/sub 3/.** Moghadam, F.K.; Stevenson, D.A. (Stanford Univ, CA, USA). *Journal of the American Ceramic Society;* **65**: No. 4, 213-216(Apr 1982).

Solid electrolytes of zirconia are used in electrochemical cells, fuel cells and for monitoring of oxygen in metals. The electrical conductivity of partially stabilized zirconia was investigated as a function of frequency (2 Hz to 100 kHz) and temperature (400/degree/to 1000/degree/C) by measuring ac admittance on a 2-probe cell using Lissajous figures. The dependence of the conductivity on annealing time was investigated with in situ conductivity measurements for prolonged annealing at 800/degree/, 900/degree/, and 1000/degree/C. The aging behavior of two commercial zirconias was studied. 20 refs.

7787 **Scan rate dependent determination of platinum areas.** Barna, G.G.; Frank, S.N.; Teherani, T.H. (Texas Instrum Inc, Dallas, USA). *Journal of the Electrochemical Society;* **129**: No. 4, 746-749(Apr 1982).

Platinum areas are determined by standard cyclic voltammetric techniques in 4M H/sub 2/SO/sub 4/, at scan rates between 20 and 100 mV/sec. A linear extrapolation of the measured charge in the H adsorption region to infinite scan rates eliminates the charge associated with the background H/sub 2/ evolution reaction. The technique allows the direct determination of the potential of full H coverage of the Pt, and hence, the generation of adsorption isotherms. The separation of H/sub 2/ evolution from H adsorption charges is shown to be more significant in the measurement of Pt areas on gas diffusion electrodes than on platinized Pt electrodes. 10 refs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

7788 **(ORNL—5925) Estimating the total impact on energy consumption of Department of Energy conservation programs.** Greene, D.L.; Hirst, E.; Soderstrom, J.; Trimble, J. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 73p. NTIS, PC A04/MF A01. Order Number DE83003168.

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The contribution of government energy conservation programs to reducing national energy use is an important but largely unresolved issue. The results of two alternative approaches for estimating the energy-savings impact of Department of Energy (DOE) conservation programs are discussed. The first approach attempts to develop program-by-program estimates of energy savings based on available program evaluations and other empirical evidence. The results of this analysis indicate that DOE conservation programs reduced total energy use by more than 0.5 quads annually as of 1981. Limitations to this approach, however, suggest that this result is best interpreted as an estimate of a lower bound of the range of overall DOE savings estimates. The second is based on an aggregate statistical modeling approach. The results of this analysis are generally consistent with significant energy savings but also indicate that any potential effect strongly depends on the price of

energy. Once again, limitations in the approach inhibit reaching unambiguous interpretations of the results.

3201 Buildings

REFER ALSO TO CITATION(S) 6961, 7721, 7755, 7837, 7841, 7843

7789 **(BMFT-FB-T—81-208) Development of an absorption heat pump system operating with primary energy to heat apartment buildings. (Dual components mixture R 22-E 181).** Schrader, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750344.

Tests have shown that the dual components mixture R 22-B 181 stays stable even in extreme situations, and reproducible measurements are obtained. Deviations from the theoretical heat ratio to the measured one are only due to under-dimensioned components. The building of a components test unit which enables a simpler component's exchange, should facilitate the experimental optimization during the project. Our project, introduced here, was aimed to develop a heat pump running on primary energy for the heating of apartment buildings. This will save on primary energy opposed to the conventionally used heating systems. Reports are about the planning, development, and construction of the first prototype as well as its operation, computing of data and evaluation. The evaluation gives many new impulses for detail improvements. In fact the influence of the jet-pump apparatus proved negative. Condenser and heater were under-dimensioned and it is advantageous not to use the adiabatically operating absorber, e.g. the removal of solution heat, because a larger de-gasing spectrum is obtainable.

7790 **(BMFT-FB-T—81-227) Saving of energy in public indoor and outdoor swimming pools.** Dittrich, A.; Kirchhoff, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750424.

Within the framework of work carried out, the possibilities for efficient utilization of energy and for the application of new sources of energy in the area of public, indoor, and outdoor swimming pools were investigated. The various measures were divided into the following categories: minimization of energy requirement, recovery of energy, and gaining of energy. They were described briefly. The estimated values for the percentage saving in primary energy and the specific costs for the individual measures are compiled in tables. This estimation of benefits and costs is limited to the consumption of thermal energy.

7791 **(BMFT-FB-T—82-128) Diesel-driven low-capacity heat pump for heating and hot-water production.** Hoefler, P. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1982. 96p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82751001.

For the F+E project it was necessary to develop a diesel engine heat pump with a small capacity primarily for use in one-family houses. The development has resulted in an air/water-type diesel heat pump with a heating capacity of 12 kW at an outdoor air temperature of +3°C using R 12 as a refrigerant. The expected efficiency factor of 1.34 could not be confirmed in the tests. An average annual value of 1.05 should be assumed. This means that the diesel heat pump cannot produce the energy savings hoped for. The problems associated with the F+E project were primarily in the area of utilization of the heat generated by the diesel engine. Among other items, the problems on the exhaust side of the diesel engine could not be solved, so that it was not possible to design a product for mass production through the research project.

7792 **(CONF-7911181—1) Energy conservation concepts for industrial and administrative buildings.** Reuter, F. (Messezentrum Nuernberg (Germany, F.R.)). [nd]. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906279.

From Energy concepts for industrial works meeting; Nuernberg, F.R. Germany (29 Nov 1979).

Measures of energy saving must consider energy distribution, energy utilization in the sphere of operation- and building-technical systems, the work management, maintenance, and building physics. The ways of energy saving can be listed in a catalogue of measures and can be presented as short-, medium- and long-term investments by a cost benefit analysis. The rational primary energy use for new buildings is now one of the preconditions of planning.

7793 **(CONF-7911181—2) High temperature heat pumps - possibilities and limitations.** Bauder, H.J. (Sulzer-Escher Wyss G.m.b.H., Lindau (Germany, F.R.)). 1979. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906264.

From Energy concepts for industrial works meeting; Nuernberg, F.R. Germany (29 Nov 1979).

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Closed compression-type heat pumps for temperatures between 100 and 130°C are soon to be introduced on the market. There are no major technical problems. Heat recovery with these heat pumps offers economic advantages already at the present level of energy prices, and these advantages are sure to increase. Favourable results are also expected for the drying sector. Various working fluids are in discussion for higher temperatures and among them are perfluoro-compounds (PP) with critical temperatures between 178 and 313°C, which have moderate pressures and high thermal stabilities (up to 400°C).

7794 **(DOE/AD/11265—T1-Vol.1) Study of energy consumption and use patterns of minorities in South Carolina, parts of Georgia and North Carolina, including socio-economic impact studies. Volume I. Energy data and analysis. Final report.** Onunkwo, E.N.; Nelson, M.A. (South Carolina State Coll., Orangeburg (USA). School of Business). Sep 1982. Contract FG01-81AD11265. 317p. D. Order Number DE83002172.

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A stratified sample of 1200 households in the 46 counties of South Carolina, 10 counties in Georgia, and 14 counties in North Carolina were selected and household interviews were conducted. Statistical tables and graphs were prepared showing energy consumption and use by income category, by type of housing, by size of household, by type of head of household, by region of state, by type of energy used, by level of education, by different States covered by the study, by age of head of household, and other study variables. Estimates for the various population parameters were developed; hypotheses established in previous studies were tested; ANOVA and chi-square tests were used to test various null and alternative hypotheses; possible explanatory variables were determined and a regression and correlation analysis between energy use and those variables was run; and the relation between disposable income and expenditure on energy was established. (MHR)

7795 **(LBL—14784) Energy savings and cost-effectiveness of heat-exchanger use as an indoor air-quality mitigation measure in the BPA weatherization program.** Turiel, I.; Fisk, W.J.; Seedall, M. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 35p. (CONF-820849—14). NTIS, PC A03/MF A01. Order Number DE83003635.

From Summer study in energy efficient buildings; Santa Cruz, CA, USA (22 Aug 1982).

The Bonneville Power Administration (BPA) has proposed a ten year program to encourage the weatherization of electrically heated homes in the Pacific Northwest. The purpose of this program is to reduce residential electrical energy demand for space heating. If air infiltration rates are reduced by employing house tightening measures, indoor air quality mitigation measures may be required in residences with significant sources of indoor air contaminants. The use of residential air-to-air heat exchangers has been proposed as a possible strategy to assure that indoor air quality is not substantially degraded by house tightening. The energy impact and cost effectiveness of heat exchanger utilization in tightened homes in the BPA region is examined. Significant energy savings are predicted if homes are tightened and heat exchangers are utilized. From the homeowner's perspective, the results of our eco-

nomic analysis indicate that, at the relatively low residential electric rates in the BPA region, the use of heat exchangers in existing homes that are tightened is not economically viable. On the other hand, from the utility perspective, it may be cost effective to use heat exchangers in the weatherization program if the marginal cost to the utility is compared with the cost of conserved energy.

7796 **(LBL—14914) Technical issues for building-energy-use labels.** Rosenfeld, A.H.; Wagner, B.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1982. Contract AC03-76SF00098. 26p. (CONF-820849—13). NTIS, PC A03/MF A01. Order Number DE83003277.

From Summer study in energy efficient buildings; Santa Cruz, CA, USA (22 Aug 1982).

Current market practice in building energy efficiency lags 15 to 30 years behind current cost-effective conservation practice, in part due to lack of credible information about home energy efficiency. It is shown that building energy efficiency labels are an attractive tool for providing this information, and that they can influence the value of a home by +- $2500. The requirements for label accuracy and some technical issues involved in designing a label are discussed and a certification process for labelling tools and users is suggested.

7797 **(LBL—15131) Advanced optical and thermal technologies for aperture control.** Selkowitz, S.E.; Lampert, C.M.; Rubin, M. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 10p. (CONF-820940—8). NTIS, PC A02/MF A01. Order Number DE83003663.

From Passive and hybrid solar energy update conference; Washington, DC, USA (15 Sep 1982).

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Control of heat transfer and radiant energy flow through building apertures is essential for maximizing thermal and daylighting benefits and minimizing undesired heating and cooling loads. Architectural solutions based on current technology generally add devices such as louvers, shutters, shades, or blinds to the glazing system. The objectives and initial accomplishments of a research program the goal of which is to identify and evaluate advanced optical and thermal technologies for controlling aperture energy flows, thus reducing building energy requirements are outlined. Activities are described in four program areas: (1) low-conductance, high-transmittance glazing materials (e.g., heat mirrors, aerogels); (2) optical switching materials (e.g., electrochromic, photochromic); (3) selective transmitters; and (4) daylight enhancement techniques.

7798 **(ORNL/CON—89) Performance and economics of eight alternative systems for residential heating, cooling, and water heating in 115 US cities.** Nephew, E.A.; Abbatiello, L.A. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 249p. NTIS, PC A11/MF A01. Order Number DE83003196.

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This study updates the results of a previous report, ORNL/CON-52, to take into account the effects of 1981 costs and technology on the performance and economics of five electrically driven heating, ventilating, air-conditioning, and water-heating systems for residences. In addition, the present study extends the analysis to include three fossil-fuel-fired systems. Current life-cycle costs and annual efficiencies are presented for 115 cities in the United States for each of the following residential systems: (1) an electric furnace, central air conditioner, and electric resistance water heater; (2) a high-performance air-to-air heat pump with electric resistance water heater; (3) a high-performance air-to-air heat pump with desuperheater water heater; (4) a minimum annual cycle energy system (ACES) of the brine-chiller type; (5) a full ACES of the brine-chiller type; (6) an advanced gas furnace, central air conditioner, and gas water heater; (7) an oil furnace, central air conditioner, and electric resistance water heater; and (8) a pulse gas furnace, central air conditioner, and gas water heater. Of the electrically driven systems, the full ACES is found to exhibit the highest annual efficiency and the highest life-cycle costs for most regions of the nation. The gas furnace system generally exhibits lower life-cycle costs than any of the other residential heating, ventilating, and air-conditioning systems and yields reasonably good annual efficiency.

7799 **(ORNL/Sub—79/24718/1) Residential conservation service planning and implementation guide.** (Oak Ridge National Lab., TN (USA); Hittman Associates, Inc., Columbia, MD (USA); United Engineers and Constructors, Inc., Boston, MA (USA)). Nov 1982. Contract W-7405-ENG-26. 209p. (ORNL/Sub—79/37902). NTIS, PC A10/MF A01. Order Number DE83003181.

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This Planning Guide has been designed to assist States in the preparation of Residential Conservation Service (RCS) Plans by explicitly defining the RCS Program and the Program Rule through practical examples. The Guide is organized as follows: plan preparation, submission, and implementation; plan coordination; state responsibilities; state criteria for utility activities; non-regulated utility participation; and home heating supplier participation.

7800 **(ORNL/Sub—81-40447/1) Proceedings of the cellulose I conference.** Anderson, R.W. (ed.). (Anderson (Robert W.) and Associates, Chanhassen, MN (USA)). Aug 1982. Contract W-7405-ENG-26. 196p. (CONF-7806212—). NTIS, PC A09/MF A01. Order Number DE82019857.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Separate abstracts were prepared for the twenty-one papers included in the proceedings on cellulose in the insulation industry.

7801 (ORNL/Sub—81-40447/1, pp 1-7) **Keynote address.** Savitz, M. (Dept. of Energy, Washington, DC). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The role of insulation, particularly cellulose insulation, is discussed in terms of energy conservation goals. The use of insulation in residential homes is reviewed for the period 1973 to 1978. The rising cost of energy and the national need for energy conservation is reviewed, with emphasis on the need for retrofitting homes with thermal insulation. The government's role in encouraging energy conservation is described and national programs to encourage conservation are discussed briefly. Building thermal envelope systems and insulating materials are described in terms of a national program and the progress of this program is reviewed. Financial incentives for energy conservation are described and the role of cellulose insulation in the overall programs is emphasized. (MJJ)

7802 (ORNL/Sub—81-40447/1, pp 8-12) **Density: test procedures.** Shirtliffe, C. (National Research Council of Canada, Ottawa, Ontario). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The importance of the density of cellulose thermal insulation is discussed in terms of its thermal resistance or R-value. Products with a density of 2 lbs/ft^3 and thickness of about 3 inches are emphasized. Installation of cellulose insulation in attics is described and various factors are considered. Settling of cellulose in attics and in walls is discussed. It is concluded that a standard is needed to assure the proper settled density of the cellulose. Standardized tests in the USA and in Canada are cited and settled density is said to be a good reference point to use in comparing materials. Results on specific houses are cited but correlation between tests in the laboratory and in actual homes is not good. (MJJ)

7803 (ORNL/Sub—81-40447/1, pp 12-19) **Density: state of the art.** Bradshaw, B. (Ther-Attic Industries, Inc., Richmond, British Columbia). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The density and R-valve of cellulose thermal insulation is discussed from the point of view of the manufacturer/applicator. It has been determined that, to obtain R-20 insulation, it is necessary to blow in an R-24.9 which will eventually settle to an R-20. Settled densities normally fall in the range of 2.5 to 3.0 lbs/ft^3. Chemical loading of cellulose (normally 6 lbs. of chemicals per 30 lbs. of cellulose) and the effect on density and on the cost of the insulation is discussed. Grinding of paper stock to produce the cellulosic state

is considered and factors affecting density are described. These are: (1) fiber length and quality of newspaper stock; (2) percentage of non-paper used; (3) moisture content; (4) chemicals used; (5) compaction during bagging or baling; (6) equipment used in blowing; (7) ventilation; (8) vapor barrier in home; and (9) climate and relative humidity. (MJJ)

7804 (ORNL/Sub—81-40447/1, pp 19-27) **Thermal resistance: test procedure.** Gilbo, C.W. Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Thermal resistance is discussed in general terms based on the definition of thermal conductivity as it would apply to the thermal insulation in a home. Equations are developed for heat flow rate/unit area and for the relationships between thermal conductivity and thermal resistance. Measurements of thermal conductivity are described with emphasis on the ASTM C-177 standard test. (MJJ)

7805 (ORNL/Sub—81-40447/1, pp 27-34) **Thermal resistance: state of the art.** McElroy, D. (Oak Ridge National Lab., TN). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The high thermal resistance of cellulose insulation is discussed in several steps based on: (1) the definition of heat flow as it relates to insulation; (2) the general data base that exists for cellulose insulation; (3) effects of temperature, thickness, and density; and (4) other factors affecting thermal resistance. It is concluded that the thermal resistance/unit thickness of cellulose insulation is high compared to other materials, but it is clearly dependent on the temperature, density, and thickness. 5 references. (MJJ)

7806 (ORNL/Sub—81-40447/1, pp 34-44) **Flame spread: laboratory measurement of the fire characteristics of cellulose loose fill insulation, a perspective.** Beyreis, J.R. (Underwriters Labs., Inc., Northbrook, IL). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Test methods are discussed to measure surface burning characteristics of materials with emphasis on building materials such as cellulose thermal insulation. The Steiner tunnel testing equipment and procedure are described and engineering background is provided. The use of the Steiner tunnel for cellulose loose fill insulation and other materials as well as other related work at the Underwriters Laboratories is discussed. (MJJ)

7807 (ORNL/Sub—81-40447/1, pp 45-50) **Flame spread: radiant panel test.** Benjamin, I. (National Bureau of Standards, Washington, DC). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

National Bureau of Standards work to determine flame spread requirements and specifications for cellulose thermal insulation are described. Two basic issues seemed involved: (1) flame travel; and (2) smoldering. A specific test is required for each. Statistics collected from the field (based on actual fires associated with insulation) were inconclusive. Prominent among these fires was cellulose insulation installed over recessed light fixtures. It was concluded that smoldering is the more serious problem. As a result, two new tests (which are described) were developed and recommended for adoption in the new Federal specification standard HH-I-515D. (MJJ)

7808 (ORNL/Sub—81-40447/1, pp 51-58) **Flash-fire propensity of cellulose insulation samples containing various borate fire retardants.** Hilado, C.J. (Univ. of San Francisco, CA); Murphy, R.M.; Sprague, R.W. Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Various samples of cellulose insulation were evaluated for flash-fire propensity, using the test method developed at the University of San Francisco. The samples included untreated cellulose insulation and insulation treated with various levels of 5-mol borax, boric acid, and mixtures of boric acid and 5-mol borax. All the treatments reduced the flame height, but there were no statistically significant differences between the treatment types. Boric acid reduced the weight loss on pyrolysis more than the other treatments.

7809 (ORNL/Sub—81-40447/1, pp 59-63) **Smoldering: a perspective.** Schaffer, E.L. (Forest Products Lab., Madison, WI). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

An overview is presented of the problem of smoldering combustion tendency of cellulose thermal insulation materials. Energy conservation concepts are discussed as well as the nature of smoldering combustion, additives added to cellulose, test methods and acceptance criteria, the geometry and orientation of the insulating material, and the gaseous environment around the insulating material. In particular, questions are raised concerning lack of knowledge in the field. (MJJ)

7810 (ORNL/Sub—81-40447/1, pp 81-112) **Smoldering: state of the art.** Anderson, R.W. (Diversified Insulation, Inc., Hamel, MN). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The testing of the smoldering resistance of cellulosic insulation has been included as a new requirement in the proposed D version of the Federal Specification HH-I-515. Using the proposed testing methodology, a series of tets has been performed to determine: (1) the characteristics of smoldering as observed in the test; (2) the effects of various test parameters; (3) the effects of various base materials (paper); (4) the effects of smoldering combustion on various chemical additives; and (5) the effects of various chemical additives on smoldering. The results of these tests, though preliminary, provide guidance for selection of chemical additives for smolder resistance and for possible modification of the testing procedure. The test results also provide direction for further research and development in the area of smolder resistant insulation materials.

7811 (ORNL/Sub—81-40447/1, pp 112-119) **Corrosiveness: test procedure.** Wilkes, P.R. (Naval Weapons Support Center, Crane, IN). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The potential corrosiveness of cellulose thermal insulation in contact with metal (steel, copper, aluminum) is discussed and a step-by-step procedure is outlined for determining the corrosiveness of a sample. The American ASTM standard test (C-739) and the Canadian equivalent are both discussed. Shortcomings in the tests are pointed out. Proposed variations and alterations to ASTM C-739 are given. (MJJ)

7812 (ORNL/Sub—81-40447/1, pp 119-127) **Codes and standards corrosiveness: state of the art.** Levinson, I.R. (Sears, Roebuck and Company, Chicago, IL). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

It is pointed out that ASTM-C-739 is the currently accepted method of testing loose fill cellulose thermal insulation for corrosiveness. Variations are proposed in the test method based on: (1) a more in-depth analysis of corrosion activity itself; and (2) showing that other insulating materials are not free from the potential of causing corrosion. Under the influence of salts present, it is proposed that the following corrosive actions could take place: (1) uniform attack; (2) pitting corrosion; (3) galvanic corrosion; (4) intergranular corrosion; (5) stress corrosion; and (6) corrosion fatigue. These are discussed in terms of shortcomings of C-739. The effect of wetting (and humidity), deliquescence, and natural substances in the cellulosic material are considered, including mineral fiber, silicate products and urea type foams. Ways to tell corrosion has taken place and the need for re-evaluation of the current tests are discussed. (MJJ)

7813 (ORNL/Sub—81-40447/1, pp 128-132) **Fungal growth, starch, odor: test procedures.** Morel, J.P. (Ontario Research Foundation, Mississauga). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Canadian government requirements (Provisional Standard 51-GP-60P) relating to cellulose thermal insulation are discussed with emphasis on the starch test, odor test, and fungal growth test. The starch test is described for both qualitative and quantitative determinations. The odor test is based on the absorption of odor in butter. Fungal growth tests are also described and demonstrated that fungal spores are present in cellulose insulation, but the problem does not appear to be serious. (MJJ)

7814 (ORNL/Sub—81-40447/1, pp 132-137) **Fungal growth, starch, odor: state of the art.** Terracina, F. (New York College of Environmental Science and Forestry, Syracuse, NY). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The composition of cellulose thermal insulating material is discussed and the molecular structure changes in going from wood to paper to cellulose material suitable for thermal insulation are explained at some length. Cellulose, hemicellulose, and lignin are defined and discussed as well as the hygroscopic nature of these materials and commercial cellulose insulating products. Interaction of fungi with wooden products and interactions (mildew, decay, etc.) are explained. Rot (white rot and brown rot) are discussed as well as wood stains and possible harmful effects on humans. It is concluded that water barriers are essential (and ventilation, if possible) to prevent water-wood product interactions. It is recommended that additional research be carried out on insulation and installation of insulation. (MJJ)

7815 (ORNL/Sub—81-40447/1, pp 137-142) **Codes and standards: control of moisture.** Gilbo, C. Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The need to control moisture in any building is emphasized and illustrated with numerous examples of buildings with moisture problems. Three basic rules for constructing buildings without moisture problems are given: (1) the building should be air-tight; (2) the building should be vapor tight on the high vapor pressure side; and (3) the building should be structurally sound and be without water leaks. (MJJ)

7816 (ORNL/Sub—81-40447/1, pp 149-154) **Quality control: what it is and ways to do it.** Crawford, R. (Thermoguard Co., Spokane, WA). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Quality control for cellulose fiber thermal insulation is defined as: The implementation of a company procedure to build a product of consistent performance and consistent composition that complies with the company procedure manual. This definition is explained and elaborated upon including topics such as information exchange, raw materials and chemicals used, acceptance testing, control systems, check lists, etc. The need for quality control is stressed. (MJJ)

7817 (ORNL/Sub—81-40447/1, pp 169-171) **Acoustics: the basics in architectural and industrial noise control.** LaCosse, R. (Cellulose Insulation Manufacturers Association, Elk Grove Village, IL). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Problems caused by noise are discussed in a general way and attempts to reduce noise in buildings, autos, railroad cars, planes, etc. are described. Measurements of sound transmission and absorption of noise are treated. The acoustical insulating properties of cellulose material are discussed in terms of decreasing sound transmission through walls and it is concluded that sound control features of cellulose should be utilized. (MJJ)

7818 (ORNL/Sub—81-40447/1, pp 172-178) **Material technology: a manufacturer's perspective.** Williamson, C. (Rhode Island Energy, Providence). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The difficulties in setting up a manufacturing plant for producing cellulosic insulation material (Rhode Island Energy Co.) are described for the period 1977 to 1978. Among the problems discussed are R-value measurement, density, pH, ratio of chemicals to fiber, paper supply, record keeping, and many other practical problems. (MJJ)

7819 (ORNL/Sub—81-40447/1, pp 178-184) **Understanding thermal insulation in building design.** Johnson, A. (Insulation Contractors Association of America, Washington, DC). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

A historical approach is taken in discussing the development of insulating materials for buildings considering such materials as ice (igloos), palm leaves, lava, sawdust, etc. The first serious beginning of the use of insulation in the USA is traced to 1887 but little seemed to develop until after World War II. Energy uses in the USA and related insulation activity to the present time are reviewed. Specific advice is given to people in the insulation industry concerning the use of insulation in buildings, performance guidelines, communication, involvement, etc. (MJJ)

7820 (PNL—4359) **Overview of existing residential energy-efficiency rating systems and measuring tools.** Hendrickson, P.L.; Garrett-Price, B.A.; Williams, T.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1982. Contract AC06-76RL01830. 178p. NTIS, PC A09/MF A01. Order Number DE83003148.

Three categories of rating systems/tools were identified: prescriptive, calculational, and performance. Prescriptive systems include rating systems that assign points to various conservation features. Most systems that have been implemented to date have been prescriptive systems. The vast majority of these are investor-owned utility programs affiliated with the National Energy Watch program of the Edison Electric Institute. The calculational category includes computational tools that can be used to estimate energy consumption. This estimate could then be transformed, probably by indexing, into a rating. The available computational tools range from very simple to complex tools requiring use of a main-frame computer. Performance systems refer to residential energy-efficiency ratings that are based on past fuel consumption of a home. There are few of these systems. For each identified system/tool, the name, address, and telephone number of the developer is included. In addition, relevant publications discussing the system/tool are cited. The extent of field validation/verification of individual systems and tools is discussed. In general, there has been little validation/verification done. A bibliography of literature relevant to the use and implementation of a home energy rating system is also included.

7821 (PNL-SA—10630) **Environmental effects of a regionwide weatherization program.** Sandusky, W.F.; Craig, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1982. Contract AC06-76RL01830. 10p. (CONF-821131—2). NTIS, PC A02/MF A01. Order Number DE83003463.

From APCA Pacific Northwest International section annual meeting; Vancouver,B.C., Canada (15 Nov 1982).

In proposing to expand the current residential weatherization program, it was determined that an Environmental Impact Statement (EIS) was necessary. The main issue addressed in the EIS is the potential effect on human health resulting from elevated indoor pollutant concentration levels due to installation of house tightening measures. The techniques used in the EIS to relate predicted indoor pollution concentration levels to effects on human health are described. The results presented are based on limited regionwide statistics on residences with various indoor pollutant sources. For those pollutants for which a risk factor has yet to be developed, qualitative estimates of effects on human health were made.

7822 (TVA/OP/ECR—82/51) Lenoir City residential thermal-storage field test. Final report. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Conservation and Rates). Fal 1981. 37p. NTIS, PC A03/MF A01. Order Number DE83900183.

The merits of residential thermal storage using magnesium-based bricks were studied by outfitting two homes in Lenoir City, Tennessee with electric thermal storage furnaces. These units were charged offpeak fom 10 pm to 7 am and also from 1 pm to 6 pm in the winter months. The two homes were billed under an experimental time-of-day rate. Results from the two years of data acquisition are presented.

7823 (TVA/OP/ECR—82-98) Field experiences underscore the importance of moisture control in energy-efficient homes. Jennings, C.W.; Moody, T.L. (Tennessee Valley Authority, Chattanooga (USA); Middle Tennessee State Univ., Murfreesboro (USA)). 13 Sep 1982. 29p. NTIS, PC A03/MF A01. Order Number DE83900060.

An investigation was initiated to evaluate and categorize problems of excessive or insufficient moisture in weatherized homes and to recommend changes to procedures or field actions as required. After a description of the properties of wood, its relationship with moisture, and its deterioration, the state of the art for moisture control is reviewed, relevant case studies are provided, and areas for further research and field study are recommended regarding the current construction practices and building codes in use. It is found that moisture problems can be controlled by controlling moisture at its source and by providing the proper ventilation. (LEW)

7824 Supply curves of conserved energy for California's residential sector. Meier, A.; Rosenfeld, A.H.; Wright, J. (Lawrence Berkeley Lab, CA, USA). *Energy (Oxford);* 7: No. 4, 347-358(Apr 1982).

A new method of presenting the potential for conservation is discussed. Supply curves of conserved energy provide a consistent accounting framework for assessing diverse conservation measures. They also permit simple comparison of conservation measures among themselves and with conventional energy supplies. The technique is applied to California's residential sector and illustrative policy conclusions are presented. Roughly ~⅓% of the natural gas and 25% of the electricity used by the residential sector could be saved at costs of conserved energy below current marginal prices. 7 refs.

7825 Investment in energy-efficient houses: an estimate of discount rates implicit in new home construction practices. Corum, K.R.; O'Neal, D.L. (Oak Ridge Natl Lab, TN, USA). *Energy (Oxford);* 7: No. 4, 389-400(Apr 1982).

Data on residential construction practices in 1975-76, together with climatic data, construction costs and fuel costs, are used to calculate discount rates implicit in homeowner's decisions to invest in energy-saving measures in new homes. This process is repeated for ten cities for three heating fuels in each city. The resulting discount rates are significantly higher than market rates of interest, suggesting market imperfections which reduce the level of investment in energy efficiency below the socially optimal level. 16 refs.

7826 International residential energy end use data: analysis of historical and present day structure and dynamics. Schipper, L.; Ketoff, A.; Meyers, S. (Lawrence Berkeley Lab, CA, USA). *Energy (Oxford);* 7: No. 2, 205-212(Feb 1982).

International comparisons of residential energy use have been hindered in the past by lack of data and common measuring systems. Ongoing efforts to disaggregate data on residential space comfort and appliance energy use for major member countries of the Organization for Economic Cooperation and Development (OECD) are reported. Indicators of structure (i.e. dwelling size, number of appliances, incomes) and of intensity (energy use per degree day, etc.) are developed for various countries and compared. It is shown that there is much room for energy conservation by reductions in energy intensity, even while structural factors (e.g. rising incomes) tend to increase energy use. 12 refs.

7827 Heat pumps combined with thermal storage. van der Ree, H. (TNO-Division of Technology for Society, Laan van Westenenk, Apeldoorn, Netherlands). pp 387-414 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Thermal storage can be applied at either the high-temperature or the low-temperature side of heat pumps. High-temperature storage is applied for shifting the electricity load on the grid, for reducing the on/off switching frequency of the heat pump and for improving a system's energy balance. Low-temperature storage can improve the averaged COP and will reduce the size of the heat pump. It is indispensable in solar assisted heat pump systems and particularly interesting when long-term storage is considered. For the same heating requirements electrical heat pumps will require larger thermal storage capacities at the evaporator side than heat activated systems. Heat pumps together with thermal storage can be realized in many forms. An interesting option is based on the intermittent sorption cycle, which can provide for thermal storage, incorporating a heat pump or a heat transformer effect.

7828 Development of heat economy and construction of concrete facade elements. Olin, J.; Ratvio, J.; Jokela, J. Espoo, Finland; Valtion Teknillinen Tutkimuskeskus (Sep 1981). 185p. (In Finnish). (VTT-TUTK—81-28). Valtion Teknillinen Tutkimuskeskus, Espoo, Finland. Order Number DE82750328.

The properties of the most commonly used insulating materials, such as mineral wool, polystyrene and polyurethane, and their possible use as insulation in concrete facade elements are studied. The carrying capacity of the load-bearing facade element is influenced by the interaction between the concrete shells. The best carrying capacity is attainable with complete interaction, which is produced, e.g. by the diagonal truss reinforcement used as wall ties. This induces, however, cold bridges and constraint forces between the shells. The more flexible anchoring methods are therefore recommended when the sufficient carrying capacity is achieved by them. The carrying capacity of the element and the size of the constraint forces due to temperature differences with different types of truss reinforcement were evaluated by means of computer calculations. The strength of truss reinforcement was examined further in the laboratory tests, in which the outer shell of the element was loaded. The concrete facade element is basically of compact structure, but with regard to heat economy and moisture conditions of the structure it is important that the joints and seams are also tight. On the other hand, when ventilating the heat insulation care should be taken that the moisture in the structure can escape outdoors. Ideas of developing the concrete facade element are introduced. Attempts were made to choose the most practical solutions on the basis of the performance analysis and the inquiry sent to the manufacturers. The most favourably judged were: the prestressed wall element of sliding form construction; the element based on the bearing capacity of the plastics insulators and on tying pins, as well as the element provided with the concentrated anchoring. Bearing capacities, manufacturing technique and costs of new structures are examined. The need for research in the field of product development as regards the wall structure and the applicable methods is also discussed.

3202 Transportation

REFER ALSO TO CITATION(S) 7868, 7889

7829 (IKE-K—54-7) Alternative developments of the energy demand on the transportation sector in Baden-Wuerttemberg. Le Van, T. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme; Stuttgart Univ. (Germany, F.R.)). Sep 1981. 156p. (In German). B. Order Number DE82750964.

Thesis. Portions of document are illegible.

A transport model is developed on the basis of valid hypothetical relations and statistical data of the transportation sector from 1960 until 1974. There are important correlations between industrial production, income and population development on one hand, and on the other, between transportation figures and energy demand. The analysis of regression based on linear and exponential

(saturation functions) operational types is used for the quantification of the model equations. The developmental possibilities of the energy demand on the transportation sector in Baden-Wuerttemberg are investigated qualitatively and quantitatively with the help of the transport model; they can serve as the basis for transport strategies and for the re-structurization of transport carriers. Future developments of transport and the energy demand required are projected until 1985 in Baden-Wuerttemberg. Various energy conservation measures are demonstrated and quantitative statements are made. In the long term, i.e. until the year 2000, the future development on the transportation sector, particularly the energy demand and the structural change of final energy, is also calculated considering the introduction of new technologies in road transport and alternative economic developments.

7830 **Analysis of the 1978-80 decline in gasoline consumption in the United States.** Greene, D.L.; Kulp, G. (Oak Ridge Natl Lab, TN, USA). *Energy (Oxford);* 7: No. 4, 367-375(Apr 1982).

Unprecendented declines in highway use of gasoline in the United States in 1979 and 1980 are analyzed by means of a gasoline demand model. Approximately half of the reduction in use in each year over the preceding year can be attributed to the short run effect of higher gasoline prices. Most of the remainder can be traced to declines in real household incomes and increasing fleet fuel efficiencies. The summer fuel shortage of 1979 appears to be responsible for 15% of the reduction in use in that year. Continuing declines are anticipated, primarily due to increasing new vehicle economy. 14 refs.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 6754, 6765, 6769, 6779, 6784, 6785, 6786, 6788, 6790, 6792, 6793, 6795, 6797, 6799, 6800, 6801, 6802, 6803, 6804, 6806, 6807, 6808, 6810, 7087, 7270, 7680, 7715, 7723, 7724, 7733, 7757, 7793, 7793, 7817, 7818, 7819, 7854, 7856, 8157, 8288

7831 **(BMFT-FB-T—81-206) Possibilities of energy conservation in the cement industry.** Daerr, G.M.; Faber, H.J.; Harr, K.; Hoffmann, U.; Neisen, H.J.; Rottenbacher, K.; Schwaemmlein, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 276p. (In German). (BF-R—63.814). NTIS (US Sales Only), PC A13/MF A01. Order Number DE82750425.

The cement industry is among the most energy-intensive manufacturing industries. According to the state of the art, the actual energy consumption is about twice to three times as high as that theoretically required for materials conversion. Taking an analysis and forecast of cement consumption in the Federal Republic of Germany as a basis, the overall energy consumption to be expected is estimated. Besides, possibilities of energy conservation are derived from a comparison of manufacturing processes and from possible modifications or improvements of the manufacturing technology. It has been found that the energy consumption can be directly reduced by shifting to the dry manufacturing process, introducing preheating and precalcining systems, and utilising the waste heat both internally and externally. Further energy conservation potentials include the improved waste heat utilisation, increasing the reaction rate (fast clinker burning), and temperature reduction by using mineralisiers. Possibilities of saving valuable primary energy are also expected to result from using energy-containing raw and waste materials and lower grade or substitute fuels. Overall, it appears likely that the energy consumption per one ton cement can be reduced by more than 3 percent. Apart from corresponding investments in plant and equipment, however, research and development expenditure is also required.

7832 **(BMFT-FB-T—82-117) SFW-Funk process for gasification of solid urban and industrial waste.** Hummelsiep, H.; Heinrich, F. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 228p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE82750998.

It was the purpose of the R+D-project, to develop the SFW-Funk process for gasification of solid urban and industrial waste for commercial plants. On the base of a literature study and some experiments on a laboratory plant, a demonstration plant was designed and built. The test runs can be divided into two sections. During the first, problems of the enlarging of the plant were examined and solved. In the second section, gasification tests where run under several conditions. During the period of run, different input-materials (domestic waste of different composition, grain size and closeners of grain, rubber and wood) were gasified at varying operating conditions (composition, quantity and constitution of the oxidant) with good results. The experiments showed, that, unless the reactor was optimized during the period of run, it is possible to optimize some further elements of the gasification plant.

7833 **(DOE/CS/24312—2, pp 6p, Section III, Paper B2) Cogeneration and small power production issues for state regulators.** Brainard, J. Aug 1982. NTIS, PC A08/MF A01. In Energy recovery from waste: workshop proceedings.

The policies of the New York State Department of Public Service are discussed as they apply to the setting of rates for cogeneration and small power producers (on-site generators) and the effect of the Public Utilities Regulatory Policies Act (PURPA). Rates are set primarily on the basis of marginal costs. Rate structures are described as well as a number of practical difficulties. Purchases of power made by on-site generators are discussed with emphasis on time-of-use rates, marginal costs, and comparisons with charges to regulatory customers. The sale of electrical power to the utility by on-site generators and the rates paid by the utility are discussed in detail with emphasis on the economics involved and the fairness of the pricing schedule. (MJJ)

7834 **(DOE/CS/24315—18) Research and development on rotary screens: concepts of a model to evaluate cost effectiveness of changes in trommel configiuration. Activities report.** Bernheisel, F.; Campbell, J. (National Center for Resource Recovery, Inc., Washington, DC (USA)). Nov 1982. Contract AC03-80CS24315. 14p. NTIS, PC A02/MF A01. Order Number DE83003309.

Progress on development of a computerized economic model of the trommel is described. Some computer analysis of trommel reliability from Recovery 1 to be used by the model has been made and is appended. (MHR)

7835 **(DOE/TIC—11378) Energy conservation and cost benefits in the dairy processing industry.** (Centec Corp., Reston, VA (USA)). 1982. 118p. NTIS, PC A06/MF A01. Order Number DE82014877.

Guidance is given on measuring energy consumption in the plant and pinpointing areas where energy-conservation activities can return the most favorable economics. General energy-conservation techniques applicable to most or all segments of the dairy processing industry, including the fluid milk segment, are emphasized. These general techniques include waste heat recovery, improvements in electric motor efficiency, added insulation, refrigeration improvements, upgrading of evaporators, and increases in boiler efficiency. Specific examples are given in which these techniques are applied to dairy processing plants. The potential for energy savings by cogeneration of process steam and electricity in the dairy industry is also discussed. Process changes primarily applicable to specific milk products which have resulted in significant energy cost savings at some facilities or which promise significant contributions in the future are examined. A summary checklist of plant housekeeping measures for energy conservation and guidelines for economic evaluation of conservation alternatives are provided. (MHR)

7836 **(EPRI-EM—2644) Electrical heating of forging billets. Final report.** Keith, R.E.; Weldon, W.F. (Texas Univ., Austin (USA). Center for Electromechanics). Nov 1982. 91p. NTIS, PC A05/MF A01. Order Number DE83900630.

Portions of document are illegible.

Recent and ongoing research concerned with homopolar generators operated in a pulse mode and making use of kinetic energy storage principles has led to the application of these techniques to forging billet heating. Most forging billet heating is done using fuel-fired furnaces, but use of electric induction heating is in-

creasing. The homopolar pulse billet heating (HPBH) process is described and its capabilities are evaluated relative to furnace and induction heating. Conclusions are that applications for this new process will most likely be in the heating of stainless steel and superalloy billets, particularly if present research efforts are successful in reducing costs.

7837 **(EUR—7061-DE) Heat recovery from waste water by energy-saving heat pump systems.** Flohrschuetz, R.; Hau, E.; Wiedmann, U. (Commission of the European Communities, Luxembourg. Directorate-General for Research, Science and Education). 1981. 282p. (In German). Commission of the European Communities, Luxembourg.

At present, the ambient heat is drawn nearly exclusively from ground and surface water, air and soil. The intensive utilization of these heat sources, however, is closely connected with ecological problems in the further dissemination of heat pump technology. As waste heat occurs especially in the form of cooling and waste water the conditions for the utilization of large heat pump plants are gives here. Starting from these reflections it is the aim of this research project to investigate the suitability of waste water as a heat source for heat pump systems and to develop technical concepts. Special attention was given to the heat exchanger problem in the naturally badly polluted waste water. Apart from the merely technical questions of heat recovery from waste water the effects resulting from the extraction of heat are also discussed. It was expected that the cooling of waste water by large heat pump plants could contribute to the thermal sanitation of flowing waters. The present report summarizes the most important results of a theoretical systems analysis of the problem. Its aim is to create the basis for further experimental investigations and to prepare the realization of practical demonstration plants.

7838 **(KFK—3112B) Environment compatible regeneration processes for ion exchange resins.** Hoell, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Feb 1981. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750426.

The most important property of ion exchange resins is that they can be regenerated and therefore be reused. Usually the regeneration is carried out with high concentrated electrolyte solutions so that concentrated saline solutions have to be diverted. In order to elevate the salt concentration of water bodies as little as possible the amount of diverted salt has to be small. This can be achieved either by suitable regeneration processes or by the use of special regeneration chemicals.

7839 **(KFK-PDV—216) Designs, guidelines and recommendations for plant automation (brewing) technological processes.** Sturm, K.H. (ed.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Prozesslenkung mit DV-Anlagen). Dec 1981. 199p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE83900597.

Portions of document are illegible.

The report, divided into three chapters, contains six papers dealing with automation of (brewing) engineering processes which were worked out in cooperation with the Technical University Berlin and the Brewing Research School (VLB). In the first chapter, conceptual designs are put forward for describing the engineering process involved and a process concept is developed from the investigations. In a future report the implemented process concept will be presented and the syntax and semantics of such modular interpretation systems (BISY) will be described. Presented in chapter 2 are the recommendations for process coupling and control of functional parts as well as their construction and service which were worked out by a PDV-working group. In chapter 3 the work in this field is supplemented by a paper of Kopetz dealing with the formulation of contracts for process computer systems.

7840 **(NP—2750331) Dehumidifiers and heat exchangers for stables.** Takai, H.; Pedersen, S. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Sep 1981. 17p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750331.

Heat consumption in cattle-stables is reduced by means of dehumidifiers and heat exchangers. Evaporators were tubes of stainless steel with dia 12 mm or aluminium tubes with exchangable filters. Heat-exchangers with coolant were working efficiently in a pigsty throughout winter, if properly maintained.

7841 **(NP—2750333) Heat recovery from ventilation air.** Takai, H.; Pedersen, S. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Sep 1981. 8p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750333.

Heat recovery from cow stable air by means of heat pumps was tested in practical conditions. The effect factor for the compressor alone varied from 2.0 to 3.5 and was best for evaporator with large cross-section. Recently there have been produced new stable heat-pumps able to produce heat at 2 different temperature levels, giving warmer water than the operating temperature of the system. Maintenance of coolant circuit and evaporator requires further improvements.

7842 (ORNL/Sub—81-40447/1, pp 142-149) **Recycled paper and the cellulosic fiber industry.** Davis, R. (Garden State Paper Co., Garfield, NJ). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

The markets for used newspapers (news print recycling industry, paperboard industry, cellulosic insulation industry, and exports) are discussed and the extent of the demands, compared to the supply, are reviewed. Projections into the future indicate that old newspapers may become in short supply, particularly in the light of solid waste conversion plants which do not separate materials which may be recycled. A plea is made for effective planning and legislation action leading to materials/energy compatibility. (MJJ)

7843 (ORNL/Sub—81-40447/1, pp 154-168) **Present variability in chemical add-on in the cellulose insulation industry.** Sprague, R.W. (Borax Research Corp., Anaheim, CA). Aug 1982. NTIS, PC A09/MF A01.

From 1. cellulose conference; St. Louis, MO, USA (27 Jun 1978).

Chemical add-ons in cellulose thermal insulation material to prevent ignition and provide flame retardance are discussed with the major emphasis on the variability of amount of chemicals added (generally 17-25.2% by weight). The use of a new additive, polybar sulfate, alone or with other formulations, is also discussed. The standard deviation between the actual amount of additives and intended add-on is 4.6%. The effects of these errors in add-ons on a typical test for fire retardancy are discussed. On the basic of numerous analyses it is concluded that variations (from intended values) of chemical add-ons complicate the task of evaluating effectiveness and that minimization of variation should be a principal focus of the quality control program. (MJJ)

7844 **(PB—82-211954) Geological aspects of industrial waste disposal: summary of a workshop. Final report.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). May 1982. 58p. NTIS, PC A04/MF A01.

In consideration of the current national attention directed at land disposal of wastes and at the urging of scientists familiar with the field problems involved, a one-day conference was held to consider geological aspects of the topic. These papers concern the role of geologists in the disposal of wastes, the great value (and scarcity) of appropriate types of geological maps for location of sites for disposal of municipal solid wastes, the problem of the contamination of aquifers, geological considerations in deep-well injection of liquid wastes, problems of disposal of wastes from the mining industry, and, in general, the great need for information on those properties of rocks that play such an important role in the underground containment of waste.

7845 (TVA/PUB—83/4) Browns Ferry waste heat greenhouse progress report II. Burch, D.W.; Carter, J.; Pile, R.S. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Agricultural Development). Mar 1982. 55p. NTIS, PC A04/MF A01. Order Number DE83900054.

The Browns Ferry waste heat greenhouse, that uses condenser cooling water for heat, was operated for two and a half years as a demonstration facility. It is divided into three zones: one using a flush-through design, one operating as a conventional greenhouse, and one operating in a closed mode. Findings and conclusions are summarized from the operational experience in a humid waste heat environment in an actual power plant setting. In particular, the engineering design and systems performance and horticultural evaluations are presented. Finally, the economic viability of power plant waste heat use in the greenhouse industry is evaluated. (LEW)

7846 Self-aligning lathe chuck jaws. Peterson, W.R. (to Department Of Energy). US Patent 4,353,561. 12 Oct 1982. Filed date 26 Aug 1980. vp.

PAT-APPL-181519.

A lathe chuck jaw for a lathe chuck having a radially moving actuator which radially moves the jaw in to and out from the workpiece. A jaw base part is rigidly connected to the actuator. A jaw shoe part is rotatably attached to the base part. The shoe part has a workpiece-comforming surface which can hold the workpiece. The rotatable attachment of the shoe part allows it to match the general orientation of the workpiece, including a nonlongitudinal orientation due to a workpiece's imperfect shape.

7847 Impact of energy conservation incentives for the industrial sector. Reister, D.B. (Oak Ridge Assoc Univ, TN, USA). *Energy (Oxford);* 7: No. 3, 247-251(Mar 1982).

Energy conservation incentives are analyzed using a simple model of energy demand in the industrial sector. The principal conclusions are: (i) The largest incentive is provided by the decontrol of energy prices. (ii) Incentives that reduce the price of capital (tax credits, accelerated depreciation, and low interest loans) have a smaller impact on energy demand than expected increases in energy prices and are cumbersome to administer. (iii) If the government wishes to encourage energy conservation, the least cumbersome method is to tax energy use. (iv) Incentives that reduce the cost of producing energy services are counterproductive because reducing the cost of energy services increases the demand for energy. 7 refs.

7848 Use of plate heat exchangers for energy economy. Cross, P.H. (Alfa-Laval Co., Ltd., Middlesex, England). *Chemical Engineer (London);* No. 378, 87-90(Mar 1982).

The design, construction, and performance of plate heat exchangers their use for heat recovery in industrial plants involved in coke manufacture and light oil recovery, the energy savings achieved and the payback period for this heat recovery equipment are discussed. (LCL)

7849 Thermal-economic analysis of heat-matched industrial cogeneration systems. Porter, R.W.; Mastanaiah, K. (Illinois Inst of Tech, Chicago, USA). *Energy (Oxford);* 7: No. 2, 171-187(Feb 1982).

Alternate cogeneration plants are compared with an existing steam only plant in terms of energy conservation and engineering economics. The concept of marginal cost of production is applied throughout. The criterion of economic selection is acceptable incremental rate of return in incremental investment based on the challenger-defender test of successively greater capital costs. As an example, coal-fired topping steam turbines as well as natural gas-fired gas turbines and oil-fired diesels with waste-heat boilers are considered to replace a gas-fired steam only plant and provide a range of electric power for the same thermal load. 13 refs.

7850 Measuring programme for the R+D project 'gasification of domestic and industrial waste'. Hummelsiep, H.; Loew, E. Bonn, Germany, F.R.; Bundesministerium fuer Forschung und Technologie (1982). 86p. (In German). (BMFT-FB-T—82-118).

Within the framework of the 'Gasification of domestic and industrial waste' R+D project, the incoming and outgoing material flows were recorded and analysed by an extensive measuring programme. Following materials were examined in detail: waste as input material, screened fine fraction, gas produced, crude gas condensate (part tar - part water), ash produced, circulating water cooling, water ashbowl, fine fraction eluate, ash eluate, waste water. As a result, quantities, compositions, energy contents and pollutant quota were determined. Energy and mass statements were drawn up based on the measuring results.

7851 Order No. 356 of 9 July 1981 on state guarantee of loan and interest subsidies for energy-saving measures in greenhouse gardening farms. Roskilde, Denmark; Risoe Library, DK-4000 (9 Jul 1981). 2p. (In Danish).

Administrative procedures related to obtaining of the state guaranteed loan and interest subsidies in gardening greenhouses are supplementing the previous law to the same effect (of 10 June 1981). Any energy saving measures in greenhouse farms are entitled to subsidies, if applications can prove the yearly energy saving to constitute at least 12,5% of the investment and if the investment bears no resemblance to any form for maintenance.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 6784, 7716, 7731, 7743, 7832, 7834, 7844, 7850, 8886

7852 (BFR-R—14-1982) Waste heat and solar energy for low temperature district heating systems. Pilot study in Kungsback, Sweden. Bernestaal, A.; Gustavsson, G.; Hultmark, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1981. 96p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82905456.

The possibilities to implement a low temperature district heating system in Kungsbacka, Sweden are investigated. By using heat pumps, a considerable fraction of the heat needed can be extracted from the waste water at the waste water purification plant. To further reduce the oil dependence, the inclusion of solar collectors and a vertical ground heat store in the system are suggested. The investment and operating costs of the project are discussed.

7853 (BMFT-FB-T—81-218) Hygienizing of sewage sludge by gamma radiation and heat treatment. Suess, A.; Schurmann, G.; Beck, T.; Rosopulo, A.; Haisch, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1981. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750427.

A final report on a project is presented about hygienizing sewage sludge. At present agriculture is an important link in the recycling process of sewage sludge form domestic waste water. However, its use is limited by the content of pathogenes. Therefore the effect of gamma-irradiated as well as of pasteurized sewage sludge on the growth of plants was investigated. For that reason the quality of irradiated, pasteurized, and untreated sewage sludge for plant production has been analysed by field and vegetation container experiments, during a three years program. In the field experiments the value of the non treated and irradiated sewage sludge for plant production proved to be equal. Heat-treated sewage sludge came off worse presumably due to an unfavourable side effect on the soil microflora. The application of irradiated sewage sludge in the plant production is recommended.

7854 (CONF-8003183—) Minimization of energy consumption in sewage treatment plants and low-pollution treatment and disposal of sewage sludge and waste. Boehnke, B. (ed.). (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Siedlungswasserwirtschaft). 1981. vp. (In German). NTIS (US Sales Only), PC A99/MF A01. Order Number DE83900098.

From 13. meeting on energy consumption in sewage treatment plants and low-pollution treatment and disposal of sewage sludge and waste; Essen, F.R. Germany (5 Mar 1980).

Separate abstracts were prepared for individual papers.

7855 **(DOE/CS/20244—1) Evaluation of technical proposals for Honolulu program of waste energy recovery.** (Honolulu City and County Government, HI (USA); Mitre Corp., Bedford, MA (USA)). Oct 1982. Contract FG01-79CS20244. 123p. NTIS, PC A06/MF A01. Order Number DE83002978.

The results of a MITRE technical analysis of four resource recovery proposals received during the HPOWER project of the City and County of Honolulu are preesented. The criteria for evaluation are discussed and a synopsis of each proposal is presented. The results of the evaluation cover three general areas: (1) technical system design, (2) system management, and (3) environmental impact. Three proposals were judged acceptable and one unacceptable. The technical evaluation was an important part of a two-step resource recovery procurement approach taken in Honolulu.

7856 **(DOE/CS/24312—2) Energy recovery from waste: workshop proceedings.** (One America, Inc., Washington, DC). Aug 1982. Contract AC01-80CS24312. 166p. NTIS, PC A08/MF A01. Order Number DE82019511.

Portions of document are illegible. Printed copy available until stock is exhausted.

Separate abstracts were prepared for papers in this workshop proceedings.

7857 (DOE/CS/24312—2, pp 3p, Section I) **Introductory remarks.** Frola, C. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Four generic benefits from the use of municipal waste are given. These are: (1) energy savings from metals and other materials that can be recycled; (2) a source of energy (2% of total energy needs); (3) enhance fuel substitution (e.g. decrease oil consumption); and (4) overcome environmental problems associated with landfills. Problems associated with waste-to-energy problems are discussed as well as the complexity of reaching an agreement with all of the people concerned (municipal officials, state officials, engineers, industry, utilities, financial community, and general public). The functions of the DOE Office of Energy from Municipal Waste are described and it is concluded that one can be cautiously optimistic about the future of waste-to-energy projects, particularly as the economics of these projects become more attractive. Difficult institutional problems are being resolved (e.g. PURPA) but it is pointed out that improved communications and understanding are necessary. (MJJ)

7858 (DOE/CS/24312—2, pp 16p, Section IV, Paper C) **Municipal perspective in regard to resource recovery or what's a nice place like New York City going to do with all that garbage.** Casowitz, P. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Motivation for a municipal in New York City to make use of solid wastes for energy production and resource recovery is outlined. Factors promoting and hindering resource recovery are listed and the magnitude of solid wastes involved is cited as well as cost and economic factors. Policy options are given and specific policy considerations for New York City are cited. Resource recovery economics are outlined as well as factors involved in specific sites (Brooklyn Navy Yard, Power Authority of New York, Port Authority of New York and New Jersey). Methane recovery from landfills (over 2500 acres in New York City) is cited as well as resource recovery as an energy source and the impact of the Public Utility Commission. (MJJ)

7859 (DOE/CS/24312—2, pp 9p, Section V, Paper B) **Participation in refuse-to-energy projects: an industry perspective.** Ganotis, C.G. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Economic relationships in refuse-to-energy projects are discussed as well as the role of political acceptability as a major driving force in implementation. The interaction of the three key parties, that is, the municipality, the contractor, and the energy user, is summarized. Basic business philosophies of the contractor and the utility are described as well as the objectives of the municipality, the energy customer and how they relate. Specific issues in energy pricing negotiations are discussed including the capacity credit, the avoided cost of energy analysis, and the relationship of the refuse-to-energy project to the utility's present and future power generation requirements. Operation experience at the Boston North Shore project is cited. Energy pricing issues and the implications of the Public Utility Regulatory Policies Act (PURPA) are discussed. It is concluded that refuse-to-energy projects can be economically successful and events in this area are changing rapidly. (MJJ)

7860 (DOE/CS/24312—2, pp 4p, Section V, Paper C) **Landfill methane recovery as a potential source of electric power generation.** Rice, F.C. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

Landfill methane recovery technology is reviewed from the first facility (Palos Verdes, California in 1973) to the present time. Currently, there are nine such facilities which are operational. These nine facilities are described briefly as well as the rapid progress in the field. The three basic elements of methane recovery projects are: (1) getting the gas out in a reliable, efficient manner; (2) processing the gas; and (3) end use of the gas. The two proven end use options for the methane gas: (1) pipeline quality gas ready for injection into the utility pipeline; and (2) medium Btu gas for sale to a nearby industrial customer) are described. Onsite electrical generation of power from raw landfill gas is discussed and, although feasible, has not yet been achieved. Problems (e.g., corrosion in the turbine generator) are described and efforts to solve the problems are reviewed. It is concluded that electrical generation from landfill gas should become a reality in the near future. (MJJ)

7861 **(DOE/CS/24456—1) State of New Jersey: resource-recovery profile.** (Opportunity Systems, Inc., Washington, DC (USA)). Oct 1982. Contract AC01-81CS24456. 100p. NTIS, PC A05/MF A01. Order Number DE83002892.

A two month study identifying all municipal solid waste to energy projects in the State of New Jersey is reported. Profiles containing historical, technological, institutional, and financial information on each project are presented.

7862 **(DOE/CS/50296—4) Alternate-fuel production facility for city of Huntsville, Alabama. Volume IV. Preliminary design and outline specifications.** (Huntsville, City of, AL (USA); Wegman (Leonard S.) Co., Inc., Buffalo, NY (USA)). Oct 1982. Contract FG01-80RA50296. 152p. NTIS, PC A08/MF A01. Order Number DE83003155.

Portions of document are illegible. Printed copy available until stock is exhausted.

Preliminary design and specifications are prepared for the following: a municipal solid waste (MSW)-to-energy facility at Lowe Industrial park consisting of two 300 TPD mass burning waterwall furnace/boiler systems, air pollution controls, MSW receipt and storage, weigh scale, tipping floor, residue/sifting/fly ash handling, cranes, maintenance and personnel facilities, buildings and building services; a three-position push-pit/compactor transfer station on the site of existing Huntsville landfill; and a steam line distribution and condensate return system to steam customers at Lowe Industrial Park. The MSW-to-energy facility will include: scale house and scales; receiving area, refuse pit, and cranes; furnace/boiler systems; tire shredder system; stacks; air pollution controls; boiler feedwater treatment system; residue storage and handling; siftings and fly-ash handling; wastewater treatment system; steam and condensate piping systems; natural gas supply and distribution system; instrument, control, and security systems; control, conference and locker rooms, offices, and equipment rooms; storage facilities, shops and maintenance areas; electrical substation; and waste oil receipt and storage area.

7863 **(NP—2906261) Report 1980.** (Deutsche Verbundgesellschaft e.V., Heidelberg (Germany, F.R.)). Jul 1981. 22p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906261.

The activities of the society in 1980 are reported both from the view of the management and of the members. The tasks and the organization of the DVG are explained. It is the purpose of the DVG, to promote the expansion of the network industry within the

German power supply industry as well as the cooperation among the German network companies and with the power supply companies of the Western European countries.

7864 **(NP—2906262) Gross-Umstadt, a junction point of the power supply system.** (Hessische Elektrizitaets-A.G., Darmstadt (Germany, F.R.)). 1979. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906262.

The history of the Hessian utility HEAG (=Hessische Elektrizitaets-AG) is reviwed from 1912 to 1979. The geographic features of the HEAG supply region and its plants are presented.

7865 **(PB—82-205634) University of florida integrated utility system conceptual feasibility analysis and assessment.** (Argonne National Lab., IL (USA)). 12 May 1978. 83p. NTIS, PC A05/MF A01.

The purpose of this study is to provide guidance on the technical and economic feasibility of an integrated utility system that would use coal and solid waste as fuels for producing steam and electricity for all of the needs of the University of Florida. The report includes the technologies of the existing system, a coal reference system, a coal cogeneration system, and an integrated utility system along with the economics of first year operation.

7866 **Thermal energy storage in community systems.** Wettermark, G. (Royal Inst. of Tech., Stockholm, Sweden). pp 197-218 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Three types of societies are outlined: that of today, based on oil; another based on coal, nuclear power, and better use of energy quality according to the second law of thermodynamics; and a third, entirely solar. Several applications are then described where thermal storage will be useful: solar heating; heat sinks and heat pumps; electrical off-peak; levelling of thermal power plants; time matching of different consumption patterns in cascade systems; distribution of heat; and total energy systems based on the sun. (LEW)

7867 **Transmission of heat using hot water pipes. Part I.** Hadvig, S. (Technical Univ. of Denmark, Lyngby). pp 301-326 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

The problems arising in connection with district heating networks are examined. These include design, utilization of thermal energy, and heat loss from district heat pipes. A theory is developed for the heat loss from pipelines in district heating systems, and its applicability is shown by two examples - pairs of separately insulated pipes and jointly insulated pairs of pipes. Some measured results obtained from an existing district heating network are also presented and compared with theoretical thermal losses. (LEW)

7868 **Temperature course in district heating pipelines.** Boehm, B.; Paulsen, O. Tastrup, Denmark; Teknologidsk Inst. (Aug 1981). 16p. (In Danish).

By means of calculations it has been established that for normal pipeline sections and massflow the precise solution of heat-loss equations differs only slightly from approximative methods. The pipeline losses should be expressed at average temperature values if heat-loss equations are not integrated. The error is greater for cellular concrete channels than for precinsulated pipes. Due to heat exchange between pipelines there can occur heating of the return pipeline in cellular concrete channels.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 7719

7869 (DOE/CS/24312—2, pp 3p, Section III, Paper B1) **Energy recovery from waste.** Rizkallah, A. Aug 1982. NTIS, PC A08/MF A01.

In Energy recovery from waste: workshop proceedings.

The proposed rules of the Florida Public Service Commission (which are similar to those of the Federal Energy Regulatory Commission), with regard to the conversion of municipal solid waste into useable fuel, are discussed. PURPA (Public Utility Regulatory Policies Act) and the role of utilities are described with emphasis on the proper interconnecting facilities. It is indicated that about 8 million tons of solid waste are available in Florida per year which could replace 3 million barrels of oil and generate approximately 300 MW of electric energy per year. Work underway for moderate waste recovery facilities are described for Dade, Hillsborough, and Pinellas Counties. The possible use of forest biomass in Florida is discussed. It is concluded that the future potential is promising for useful conversion of solid waste materials. (MJJ)

7870 **(DOE/TIC/EGC—82/3) Energygrams: brief descriptions of energy technology.** Simpson, W.F. Jr. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Sum 1982. 100p. NTIS $8.00. Order Number DE83001868.

Portions of document are illegible. Printed copy available until stock is exhausted.

This compilation of technical notes (called Energygrams) is published by the Technical Information Center. Energygrams are usually one-page illustrated bulletins describing DOE technology or data and telling how to obtain the technical reports or other material on which they are based. Frequently a personal contact is given who can provide program information in addition to the data found in the reports. The compilation is organized by subject categories, and, within each category, Energygrams are presented alphabetically by Energygram title.

7871 **(NP—3900070) Acquiring a curricular disposition and developing unitized sets for electrochemistry especially regarding technological processes.** Esser, L. (Gesamthochschule Paderborn (Germany, F.R.). Fachbereich Chemie und Chemietechnik). 1981. 522p. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE83900070.

Thesis.

A curricular concept is developed for upper secondary which gives an experimental introduction to electrochemistry with a special view to technological processes. Experimental set-ups and teaching lessons have been developed which take into account the possibilities and requirements of teaching practice and involve little expenditure. A unitized set is developed on the basis of a few standard modules; it can be extended and used beyond the experiments described in this paper.

7872 **Implementing cultural science in the high schools.** Marshall, W.L. (Oak Ridge National Lab., TN). *Journal of Chemical Education;* **58**: No. 10, 770-772(Oct 1981). Contract W-7405-ENG-26.

Some general proposals that have been made to teach cultural science to the high school students are briefly reviewed. An attempt is then made to describe pre-college science education with respect to teacher, student, nature of textbooks, and attitudes. That a course in cultural science should be adopted throughout the high schools is reaffirmed. The rationale for cultural science and measures necessary to change from specialized science to a cultural approach are explained.

7873 **Appropriate education for appropriate rural technologies.** Adibe, N. (Long Island Univ., Greenvale, NY). pp 284-285 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper addresses the need for and the description of an appropriate science/technology education program geared to the recipients of technologies innovations in rural parts of the world. (RJC)

7874 **Training the international development worker in appropriate community technology.** Clavaud, D.; Goldman, L.; Szecsey, C.; Warpeha, P. (Farallones Inst. Rural Center, Occidental, CA). pp 286-292 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper presents an example of an integrated approach to training development workers in the application of renewable sources of energy, and one possible methodology for training programs. The training program described emphasizes the application of small-scale technologies within the broader context of both technological innovation and social change. Discussed are: the philosophy of the program; the goals of the program; and the design of the program. A summary of a pilot training program undertaken at the Farallones Institute Rural Center to develop training materials and train future Peace Corps Volunteers in appropriate technology is presented. (RJC)

7875 **Minds, manure and muscle: application of science in the classroom to world problems in energy and agriculture.** Puleo, L. (Colorado Mountain College, Glenwood Springs). pp 497-482 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper details a new type of curriculum being developed to make American high school teachers and students aware of world energy and food problems and to begin to work on possible solutions. The curriculum has been built on an interdisciplinary approach to the relationship between energy consumption and food production. Wise use of energy, land, water, and chemicals is emphasized. There are six aspects to the curriculum which are discussed by the author. The six aspects are: solar energy, sewage sludge recycling, aquaculture, triticale (plant tissue culture techniques), apiculture, and the prudent use of water. (RJC)

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

7876 **(CONF-8009288—1) Future requirements on diesel engines for passenger cars.** Kuck, H.A. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.)). [nd]. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906263.

From Seminar on diesel engines; Wuppertal, F.R. Germany (18 Sep 1980).

The increasing shortage of world oil reserves has made economy, low fuel consumption and low emissions increasingly important. As a consequence, diesel cars are now offered or will soon be offered by all major producers of passenger cars. Present diesel engines for passenger cars are all based on the chamber principle. Especially the lower noise level and the increased power per liter have made the diesel engine suitable also for compact vehicles with a weight of less than 1000 kg. In spite of some uncertainties to be expected of the future, the following points can be stressed as future requirements on diesel engines: 1) Meeting of future emission restrictions world-wide. 2) Consumption of 20-30% less fuel than the Otto engine.

7877 **(DOE/NASA/0091—1) Fumigation of alcohol in a light duty automotive diesel engine.** Broukhiyan, E.M.H.; Lestz, S.S. (Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies). Aug 1981. Contract AI01-81CS50006. 120p. (NASA-CR—167915; CAES—600-81). NTIS, PC A06/MF A01. Order Number DE83002974.

Portions of document are illegible. Printed copy available until stock is exhausted.

A light-duty automotive diesel engine was fumigated with methanol and ethanol in amounts up to 35% and 50% of the total fuel energy respectively. The main purpose of this study was to determine the effect of alcohol (methanol and ethanol) fumigation on engine performance at various operating conditions. Engine fuel efficiency, emissions, smoke, and the occurrence of severe knock were the parameters used to evaluate performance. Raw exhaust particulate and its soluble organic extract were screened for biological activity using the Ames Salmonella typhimurium assay. Results are given for a test matrix made up of twelve steady-state operating conditions. For all conditions except the 1/4 rack (light load) condition, modest thermal efficiency gains were noted upon ethanol fumigation. Methanol showed the same increase at 3/4 and full rack (high load) conditions. However, engine roughness or the occurrence of severe knock limited the maximum amount of alcohol that could be fumigated. Brake specific NO/sub x/ concentrations were found to decrease for all ethanol conditions tested. Oxides of nitrogen emissions, on a volume basis, decreased for all alcohol conditions tested. Based on the limited particulate data analyzed, it appears as though ethanol fumigation, like methanol fumigation, while lowering the mass of particulate emitted, does enhance the biological activity of that particulate.

7878 **(KFK-AFR—003, pp 14) Application of radionuclide techniques in mechanical engineering - wear measurements in internal combustion engines.** Moeller, H. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

7879 **(NP—2906266) Technical and administrative measures to reduce noise in automobile diesel engines.** Kemper, G. (Umweltbundesamt, Berlin (Germany, F.R.)). [nd]. 16p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906266.

The most common political strategy of noise abatement in automobiles is to set limiting values for all vehicles. Although this measure has not been too efficient in the past, progress is now made in new requirements set by various institutions. Existing and future limiting values for the EC and Switzerland are presented in a table - Switzerland was choosen as the country with the most rigid demands on an international scale. Targets set by the West German Government for 1985 for EC discussions are listed. These values are still in the proposal stage and have not yet been agreed upon by the EC.

7880 **(NP—3900216) Window to observe the processes going on inside the combustion space of diesel engines.** Taucar, G.; Werlberger, P. (Technische Univ., Graz (Austria). Inst. fuer Verbrennungskraftmaschinen und Thermodynamik). Apr 1980. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83900216.

All optical research methods of combustion processes in internal combustion engines need adequate windows. One problem remained unsolved up to now: the quick sooting of the windows which limited the time for observation. The present report deals with the development of a soot-free window which provides unlimited time for observing under all stress conditions. This window permits spectroscopic studies of the combustion as well as optical studies of the carbureation and the combustion to be carried out.

7881 **(NP—3900304) Experimental investigation of heat transfer in spark ignition engines.** Fieger, J.M. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Verbrennungskraftmaschinen und Kraftfahrzeuge). 30 Sep 1980. 143p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83900304.

Thesis.

This thesis aims at finding an equation for the heat transfer coefficient of the Otto-engine in order to create the necessary boundary conditions for the precalculation of the operational behaviour and of the thermal stress of the components. Systematic

tests of all performance characteristics of an MTU-single-cylinder-gas-engine and a BMW-engine were made using two independent test methods for the experimental determination of the heat transfer, the validity of the chosen equation for all tested material was examined and fully confirmed.

7882 **(NP—3900334) Contribution to the calculation of the transient operating behaviour of medium-speed diesel engines for ship propulsion.** Boy, P. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 7 Feb 1980. 199p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE83900334.

Thesis.

On the basis of steady-state cycle process calculation, a mathematical model is developed which serves to describe the transient operations of medium-speed ship propulsion engines. For this purpose the engine is divided into control containers and the state variables in the individual containers are cyclically determined with the fill- and discharge method. The exhaust gas turbocharger provides the boundary conditions of the system whereas the description of the combustion process is done by means of the Vibe-substitute combustion process. In each mathematical operation the change of the turbocharger speed is calculated from the energy balance of the exhaust turbocharger while the change of the engine speed is calculated from the difference of engine- and load torque. The system of differential equations is solved according to the Runge-Kutta, respectively the Predictor-Corrector method. In order to confirm the mathematical model test, measurements were carried out with medium-speed diesel engines. Characteristic engine parameters under steady-state and transient conditions were determined and evaluated. A comparison between the measured steady-state and transient operational parameters showed satisfactory agreement. The calculations show further that the present mathematical model permits detailed studies of the transient behaviour of supercharged diesel engines as early as the project stage to be carried out, it also permits a better comprehension of the operations of the exhaust gas turbine of turbocharged engine.

7883 **(NP—3900336) Influence of air ratio and ignition point on energy consumption and radiation emission of a spark ignition engine.** Thoms, U. (Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik). 21 Apr 1980. 159p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83900336.

Thesis.

The thesis outlines the combustion process in an air-cooled single-cylinder engine run on gaseous propane. Special attention is paid on energy conversion processes and the pattern of radiation emitted by the charge. Radiation was measured with optical probes with small and wide opening angle, they served to transmit radiation from selected charge sections to broadband sensitive photomultipliers by means of flexible light tubes.

7884 **(NP—3900337) Investigation of a direct-injection stratified-charge method.** Schmidt, G. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 19 Feb 1979. 144p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83900337.

Thesis.

As a result of the low fuel consumption of fuel injection systems, stratified charge engines with this type of system are of topical interest. The intention of the present thesis is to contribute to the elucidation of the various parameters influencing this stratified charge technology derived from the diesel engine. Special attention will be paid to the influence of the most important parameters on economy and the emission of exhaust fumes. This includes compression ratio, thermodynamics, geometry of the combustion chamber and injection as well as the parameters influencing carburetion, the ignition and the combustion process like injection start and ignition timing. A further subject of research is the process of the engine operated on a homogeneous basic mixture and direct fuel injection, the influence and realizability of which will be assessed.

7885 **Multidimensional numerical simulation of reactive flow in internal combustion engines.** Butler, T.D.; Cloutman, L.D.; Dukowicz, J.K.; Ramshaw, J.D. (Los Alamos Natl Lab, NM, USA). *Progress in Energy and Combustion Science;* 7: No. 4, 293-315(1981).

A selective review is given of numerical methods for performing multidimensional simulations of the chemically reactive fluid flow in an internal combustion engine cylinder. Particular emphasis is placed on the major areas of numerical difficulty, their physical origins and the methods that have been proposed for their amelioration. Available computer codes and their capabilities are summarized, and an illustrative calculation is described. 153 refs.

3302 External Combustion Engines

7886 **High pressure/high temperature hydrogen permeability in candidate Stirling engine alloys.** Bhattacharyya, S.; Vesely, E.J. Jr.; Hill, V.L. (Ill Inst of Technol Res Inst, Chicago, USA). *Journal of Materials for Energy Systems;* 3: No. 4, 12-21(Mar 1982).

Hydrogen permeation tests of eight high-temperature alloys were conducted in 20.7 MPa hydrogen at 923 to 1088 K for assessing suitability in Stirling engine application for heater head and heater head tubing. The iron-nickel-base alloys investigated included N-155, Incoloy 800 (IN 800), A-286, and 19-9DL, and cast alloys CRM-6D, SAF-11, and XF-818. Low carbon alloys Stellite 6B (6BLC), a cobalt-base wrought alloy, was also investigated. 15 refs.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 7398, 7693, 8111

7887 **(NP—3900305) Field and force distribution in asynchronous short-stater linear motors in steady-state and transient operation.** Braemer, D. (Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik). 30 Oct 1979. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83900305.

Thesis.

The thesis deals with field problems and power effects of asynchronous linear motors. The first chapters describe the effects of the finite length and breadth of linear motors on the field- and power distribution in steady-state operating conditions with special regard to disturbancies of field- and power distribution by the finite lengths. The second part deals with transient processes, where it proved to be useful for the calculation if mechanical processes are separated from transient processes. The theoretical results are confirmed by experiments.

7888 **(UCID—19576) Roadway powered electric vehicle project. Final report.** Walter, C.E.; Salisbury, J.D. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1982. Contract W-7405-ENG-48. 54p. NTIS, PC A04/MF A01. Order Number DE83003147.

Portions of document are illegible.

The Roadway Powered Electric Vehicle (RPEV) project of Lawrence Livermore National Laboratory was begun in 1979 to conduct tests of the roadway and the vehicle and to investigate the impact on electric utility generating capacity of wide-scale deployment of powered roadways. Information is presented on: the analysis of the RPEV system performed to identify the parameters of importance and to provide a framework for testing; the test facility which contains a 220-m long test track with a 50-m long powered section; the tests performed to measure the safety, driveability, compatibility, and power losses of the system; the data obtained from these tests; and analyses performed to determine the cost and benefits of RPEV's and their impact on electric utilities in terms of increased power demand. The results indicate that RPEV's are technically feasible, power pickup efficiencies as high as 96% were obtained, the system is safe, the dependence of transportation on petroleum would be reduced by the use of RPEV's, the capital cost of the system is manageable, and the impact on electric utilities de-

pends on the areas in which RPEV's are deployed. The RPEV project is being terminated due to lack of funding. (LCL)

7889 Inductive power transfer for propulsion. Walter, C.E. (Lawrence Livermore Natl Lab, CA, USA). *Journal of Advanced Transportation;* **16**: No. 1, 73-86(1982).

Application of the concept of inductive power transfer to the propulsion of buses, automobiles, and trucks can contribute to a quality national transportation system. The concept is basically an air gap transformer which inductively couples the primary in the roadway to the secondary suspended beneath the vehicle. Power is transferred efficiently in this manner and can be used in an electric motor for propulsion. The concept originated nearly 100 years ago, but only recently received attention as a means of providing quality highway transportation with little visual and audible presence, no noxious fumes, and without dedicated use constraints. Implementation of this concept could reduce the present, nearly complete, dependence of transportation on petroleum. Current investigations include a detailed experimental program, evaluation of the impact on electrical utility generating capacity and early applications in transit. Progress has been slowed by federal government funding limitations; future progress will be impeded unless new support is forthcoming. 5 refs.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 7890

3305 Flywheel Propulsion

7890 (UCRL—15502) Study of vacuum systems for a heat engine/flywheel automotive propulsion system. Final report. Lieber, M.D. (AiResearch Mfg. Co., Torrance, CA (USA)). 11 Jul 1982. Contract W-7405-ENG-48. 72p. NTIS, PC A04/MF A01. Order Number DE83002284.

This study investigated vacuum systems for a heat engine/flywheel automotive propulsion system. A vacuum environment is required to keep rotational losses and subsequent overheating of the flywheel energy storage unit (ESU) to a minimum. The overall vacuum system includes the vacuum pumps, flywheel shaft seals, vacuum sensors, tubing and any other components expressly designed with the purpose of maintaining the vacuum level in the ESU. The vacuum pump is the main component of the overall vacuum system and as such, most of this report details with selection of a vacuum pump. This study provides information for selecting a vacuum system design with the ultimate goal of incorporating the flywheel into a mass-produced automotive vehicle.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 7885

3307 Emission Control

REFER ALSO TO CITATION(S) 8297

7891 (NP—3900243) Poisoning of noble metal catalysts by silicon compounds during the catalytic afterburning. Eikmeier, H.B. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Chemie, Biologie und Geowissenschaften). 12 Nov 1980. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83900243.

Thesis.

The poisoning of Pt-carrier catalysts by silicon organic compounds in oxidizing atmosphere is discussed. The aim is to find out suitable analytic methods to determine the poisoning parameter and to perform kinetic measurements at the catalyst during the poisoning. The poisoning reagent is adsorbed and oxidized to SO_3 at the active centres. A semi empirical formula for the calculation of the deactivation time is developped under the boundary condition of a monomolecular aquivalent layer on the Pt-surface. Only hot HF is applicable to regenerate the catalyst. A poisoning is only prevented by hydrolysing.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 7877

7892 (DOE/CE/50179—1-Vol.1) Assessment of methane-related fuels for automotive fleet vehicles: executive summary. (Aerospace Corp., El Segundo, CA (USA)). Feb 1982. Contract AC01-80CS50179. 51p. NTIS, PC A04/MF A01. Order Number DE83000280.

Portions of document are illegible.

The use of methane-related fuels, derived from a variety of sources, in highway vehicles is assessed. The term methane, as used in this report, includes and is interchangeable with natural gas (NG) as well as synthetic (or substitute) natural gas (SNG), provided methane is the predominant constituent. Methanol is included in this study because it can be produced from NG or the same resources as SNG, and because it is a liquid fuel at normal ambient conditions. Technological, operational, efficiency, petroleum displacement, supply, safety, and economic issues are analyzed. The assessment is intended to satisfy Section 7(a) of the Methane Transportation Research, Development, and Demonstration Act of 1980 (PL 96-512), which focuses on expanded methane use in automotive fleet vehicles and farm equipment.

7893 (NP—2750334) Rapeseed-oil as a fuel for diesel engines. (Landsudvalget for Bygninger og Maskiner, Viby (Denmark)). Nov 1981. 39p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750334.

The Danish agricultural cooperation authorities evaluate economic consequences of rapeseed oil use as admixture to diesel fuels. 25,50 and 100% rapeseed oil have been tested succesfully in a Mercedes diesel engine. At present the Danish rape acreage is 145,000 ha (ca. 63% of the total cultivated acreage) and can be increased, if rapeseed oil proves to substitute imported diesel oil. Oilcakes containing up to 7% oil are valuable cattle-feed. New rape types with low erucic, linolenic acid and glucosinolate concentration but high linoleic acid contents are being developed in order to achieve 40% lineoleic acid concentration. Prices of the new improved sorts have to be 10% higher than the traditional ones to make cultivation attractive for EC agriculture.

36 MATERIALS

REFER ALSO TO CITATION(S) 6895, 7236

7894 (GKSS—81/E/44) Introduction into fracture mechanics. Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie). 1981. 96p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750428.

The present report gives an introduction to the basic principles of fracture mechanics. First the behaviour of a linear elastic body containing a crack is described. This is followed by a survey of experimental methods for the determination of fracture mechanics properties, like R-curve and fatigue crack growth. Two chapters deal with the most important parameters affecting stable crack growth and fracture toughness. The knowledge of the limits of applicability of linear eleastic fracture mechanics and of the concepts of elastic-plastic fracture mechanics is of particular importance. The last chapter deals with some basic procedures for the practical application of fracture mechanics.

7895 (UCRL—50980) Light-armor program. Fifth progress report. Wilkins, M.L.; Landingham, R.L.; Honodel, C.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1971. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01. Order Number DE83002281.

Portions of document are illegible.

Techniques are given for the fabrication of new lightweight armor materials that provide a 15% weight savings over the best available lightweight armor. The effect of ceramic microstructure on ballistic limits is discussed. Direction is given for the synthesis of an avant garde material for applications other than lightweight

armor. Information is given for scaling .30-cal data to different ballistic threats. 51 figures, 11 tables.

7896 **Laser heterodyne surface profiler.** Sommargren, G.E. (to Department Of Energy). US Patent 4,353,650. 12 Oct 1982. Filed date 16 Jun 1980. vp.

PAT-APPL-159893.

A method and apparatus is disclosed for testing the deviation of the face of an object from a flat smooth surface using a beam of coherent light of two plane-polarized components, one of a frequency constantly greater than the other by a fixed amount to produce a difference frequency with a constant phase to be used as a reference. The beam also is split into its two components with the separate components directed onto spaced apart points onthe face of the object to be tested for smoothness. The object is rotated on an axis coincident with one component which is directed to the face of the object at the center which constitutes a virtual fixed point. This component also is used as a reference. The other component follows a circular track on the face of the object as the object is rotated. The two components are recombined after reflection to produce a reflected frequency difference of a phase proportional to the difference in path length which is compared with the reference phase to produce a signal proportional to the deviation of the height of the surface along the circular track with respect to the fixed point at the center.

7897 **Rf sputtering for preparing substantially pure amorphous silicon monohydride.** Jeffrey, F.R.; Shanks, H.R. (to Department Of Energy). US Patent 4,353,788. 12 Oct 1982. Filed date 26 Aug 1980. vp.

PAT-APPL-181410.

A process for controlling the dihydride and monohydride bond densities in hydrogenated amorphous silicon produced by reactive rf sputtering of an amorphous silicon target. There is provided a chamber with an amorphous silicon target and a substrate therein with the substrate and the target positioned such that when rf power is applied to the target the substrate is in contact with the sputtering plasma produced thereby. Hydrogen and argon are fed to the chamber and the pressure is reduced in the chamber to a value sufficient to maintain a sputtering plasma therein, and then rf power is applied to the silicon target to provide a power density in the range of from about 7 watts per square inch to about 22 watts per square inch to sputter an amorphous silicon hydride onto the substrate, the dihydride bond density decreasing with an increase in the rf power density. Substantially pure monohydride films may be produced.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 6884, 6894, 6897, 6955, 7005, 7086, 7086, 7237, 7245, 7460, 7460, 7461, 7465, 7465, 7472, 7475, 7477, 7493, 7497, 7497, 7520, 7524, 7635, 7787, 7811, 7812, 7998, 8085, 8096, 8498

7898 **(CONF-8105193—) Corrosion due to salt water.** (Fachhochschule Wilhelmshaven (Germany, F.R.)). 1981. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83900248.

From 2. meeting on corrosion due to salt water; Wilhelmshaven, F.R. Germany (14 May 1981).

The first meeting on corrosion due to salt water was held at Fachhochschule Wilhelmshaven in 1977. The second meeting, abstracts of which are presented in this volume, will give engineers of producer and operator companies a practical picture of salt water corrosion problems and of ways to avoid or at least reduce them. Corrosion problems may also be caused by marine flora and fauna which settles on the systems and impairs their function, accordingly, possibilities of preventing this are discussed at length.

7899 **(DESY-SR—81/08) 4f-surface binding energy shift for Eu and Gd metals.** Kammerer, R.; Barth, J.; Gerken, F.; Flodstroem, A.; Johansson, L.I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750430.

Synchroton radiation excited photoemission spectra of Eu and Gd are presented. For Eu a 4f-surface component is resolved with 0.63 eV binding energy shift. For Gd the comparison with XPS data gives strong evidence for a surface shifted 4f-component (ΔE = 0.48 eV). The mean free path of photoelectrons is determined.

7900 **(DOE/ER/06039—3) Testing to qualify steels for hydrogen service.** Louthan, M.R. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1982. Contract AS05-78ER06039. 8p. (CONF-821127—2). NTIS (US Sales Only). Order Number DE83001527.

From ASM conference on current solutions to hydrogen problems in steels; Washington, DC, USA (1 Nov 1982).

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The apparent susceptibility of a material to hydrogen damage is influenced by a wide variety of environmental and test variables. Strain rate, stress state, nature of the hydrogeneous environment, temperature, surface finish, metallurgical condition and pre-exposure hydrogen content, all have significant effects on hydrogen induced degradation. Many of these variables are not well controlled when a structural material is placed in hydrogen service. Therefore, prediction of in-service hydrogen compatibility is difficult and sometimes the available test data can be misleading. This paper emphasizes the importance of macroscopic stress state in controlling the susceptibility of a steel to hydrogen embrittlement and suggests that for predictative capabilities any qualification program for determination of the in-service hydrogen compatibility of a steel must include rising load J/sub IC/ or K/sub IC/ tests, evaluation of a ΔK/sub TH/ and determination of microstructural effects on hydrogen compatibility. Tensile tests and studies with cathodically charged samples are shown to be of little value in the assessment of the likelihood of in-service hydrogen induced failure. 9 figures, 2 tables.

7901 **(DOE/ER/06039—4) Influence of externally imposed constraint on the hydrogen embrittlement of steels.** Muraii, J.; Louthan, M.R. Jr.; McNitt, R.P.; Sisson, R.D. Jr. (Conoco, Inc., Ponca City, OK (USA); Pennsylvania State Univ., University Park (USA); Pennsylvania State Univ., University Park (USA). Dept. of Engineering Mechanics; Exxon Chemical Co., Florham Park, NJ (USA)). 1982. Contract AS05-78ER06039. 8p. (CONF-821127—1). NTIS (US Sales Only). Order Number DE83001526.

From ASM conference on current solutions to hydrogen problems in steels; Washington, DC, USA (1 Nov 1982).

Mf only; illegibility does not permit PC reproduction.

This paper describes the results of an experimental program on the hydrogen damage of high and low strength steels using different test techniques that varied the stress state and the constraint imposed on the material. The influences of gaseous and electrolytic hydrogen on the embrittlement characteristics of high-strength 4340, A106B, and AISI 1015 steels were studied via a series of tensile, delayed failure, disk rupture, and fracture mechanics tests. Results indicate that externally imposed constraint plays a vital role in the hydrogen damage of high-strength steels. However, in the case of low-strength steels, externally imposed constraint was found to be unimportant for hydrogen-induced cracking. Also, it was found that fracture modes were characteristic of the constraint dependence of the material with regard to hydrogen-induced cracking. The pros and cons of the constraint agreement and its relevancy to material and experimental variables in determining the material's susceptibility to hydrogen damage are discussed. 17 figures, 7 tables.

7902 **(DOE/ER/10556—94) Some aspects of the plastic deformation of phase mixtures with coarse microstructures.** Gurland, J. (Brown Univ., Providence, RI (USA). Dept. of Engineering). Oct 1982. Contract AC02-80ER10556. 30p. (CONF-820982—1). NTIS, PC A03/MF A01. Order Number DE83001624.

From Yield, flow and fracture in polycrystals meeting; Glasgow, UK (1 Sep 1982).

This paper discusses plastic deformation of two-phase alloys, the partititon of stress and strain between the soft and hard constituents, and the applicability of mixture laws. Dual-phase steels are considered in particular. At all strains, plastic deformation takes place mainly in the ferrite. The martensite resists plastic deforma-

tion at low strain but is ductile. The martensite particles supplies the desirable dispersion hardening effect, enhanced strain hardening rate and resistance to plastic instability such as necking, while yielding plastically at high strains. 12 figures. (DLC)

7903 **(DOE/ET/26962—T1) Roles of rate and state of stress in controlling susceptability to hydrogen embrittlement. Annual report.** Louthan, M.R. Jr.; McNitt, R.P. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Coll. of Engineering). Oct 1979. Contract AS05-76ET26962. 94p. NTIS (US Sales Only). Order Number DE83000354.

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Interactions between stress, state, strain rate and type of hydrogen exposure (pre-charged, or environmental) were examined in a series of experiments with A106, 4340 and 4370 steel. Implications of the results to hydrogen transmission and storage systems show the difficulties inherent in the extrapolation of data from one stress-state-hydrogen system to different operating environments. The experiments included fracture mechanics measurements on compact tension A106 specimens tested in either hydrogen or oxygen gas, delayed failure tests of 4340 specimens stressed to either a biaxial or uniaxial surface stress via bending, burst testing of smooth and pre-flawed AISI 1015 specimens through the pressurization with either hydrogen or oxygen, sustained and cyclic loading of A106 tubular samples where the applied stress resulted from a combination of axial load and internal pressurization, and torsional fatigue of notched and smooth 4370 specimens in low pressure hydrogen gas. The diversity of the results are indicative of inherent difficulties in qualifying a material by a test program that is not representative of proposed operating environment. 50 figures.

7904 **(GKSS—79/E/54) Irradiation techniques for large reactor pressure vessel steel specimens.** Ahlf, J.; Bellmann, D. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie). 1981. 18p. (CONF-790646—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750347.

From International colloquium on irradiation for reactor safety programmes; Petten, Netherlands (25 Jun 1979).

An irradiation rig has been designed which is capable of irradiating compact tension specimens up to 100 mm thickness in swimming-pool type research reactors. The space for specimens is 260 mm wide and 500 mm high, the depth can be varied between 50 mm and 120 mm. The rig is equipped with a gas mixing system and electric heaters for coarse and fine temperature control, the design temperature is about 300°C. The decrease gamma-heating in the specimens and thereby reducing temperature gradients an absorber shield can be placed between the reactor core and the irradiation rig. Stainless steel, lead and tungsten are under consideration as absorber materials. Irradiation embrittlement is sensitive to neutron fluence, irradiation temperature and also to the neutron energy spectrum. These parameters have significant gradients in the specimen volume. In a supporting effort the neutron and temperature fields are calculated and measured and the consequences on the evaluation of fracture toughness data are investigated. A prototype rig with a stainless steel gamma shield has been built and successfully operated in FRG-2.

7905 **(GKSS—81/E/60) Effects of neutron-irradiation on the properties of $Fe_{40}Ni_{40}B_{20}$.** Gerling, R.; Wagner, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750689.

Amorphous $Fe_{40}Ni_{40}B_{20}$ has been exposed to reactor irradiation with fluences of thermal neutrons up to 6.5×10^{19} n/cm^2. The nuclear reaction B^{10} (n, α) Li^7 + 2.3 MeV, caused by the capture of thermal neutrons led to damage levels up to 26 dpa. Subsequent investigations of the irradiated material by transmission electron microscopy showed, that the material remained amorphous under neutron-irradiation. Irradiation induced defects could not be detected. Thermal analysis of these specimens revealed that after irradiation to 6.5×10^{19} n/cm^2 the amorphous structure appeared to be less stable with respect to the as-quenched material. Bending tests yielded a drastic loss in ductility after 1×10^{19} n/cm^2.

7906 **(Juel—1725) Resonant vibrations of self-interstitials in fcc metals with application to specific heat and neutron scattering.** Ram, P.N.; Dederichs, P.H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Jul 1981. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750447.

Some aspects of resonant vibrations of self-interstitials in the 100-dumbbell configuration in fcc-metals are discussed by extending previous calculations of Zeller et al. and Schober et al. Employing a simple defect model with nearest-neighbour interaction the local frequency spectrum of the defect is calculated showing several localized modes and low-frequency resonant modes. The change in the total density of states due to the defects is expressed as the derivative of a generalized phase shift which is used to calculate the change in the lattic specific heat due to single interstitials. Inelastic neutron scattering away from the one-phonon lines is proposed as a method to observe the resonant modes induced by self-interstitials. The model calculation in Cu shows that the well defined resonant modes due to dumbbell vibrations have appreciable intensity and could presumably be detected in neutron scattering measurements. The effect of di-interstitials on the phonon dispersion in Al is also discussed.

7907 **(KFK—3130e) Annual report on research and development 1980 of the Institut fuer Technische Physik.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik). Jun 1981. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750431.

Progress of the following working areas of the institute is reported: magnets for fusion technology (TESPE experiment, the Large Coil Task (LCT)); components and technology (development of high field superconductors (Nb_3Sn, Nb_3Al)), cooling techniques (HELITEX experiment); system studies on fusion reactor components; magnets for research and technology; basic research related to superconductivity; cryo-energy technology; the cryogenic engineering infrastructure of the institute.

7908 **(KFK—3205) Investigation on structural distortions in NBCsub(x)-single crystals by means of temperature dependent channeling measurements.** Kaufmann, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1). Aug 1981. 127p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750345.

Investigations using channeling-experiments were performed on the magnitude of the static displacements of the niobium and the carbon atoms around C-vacancies in NbCsub(x)-single crystals (x = 0.82-0.98). Rutherford backscattering with 2 MeV He^+-particles and the $^{12}C(d,p)^{13}C$-nuclear reaction with 1.27 MeV deuterons were used for the determination of the interaction yields from Nb and C, respectively. As a function of temperature the half widths at half maximum psisub(1/2) of the angular scans for Nb clearly increased with decreasing temperature in the range from 295 K to 78 K and then remained nearly constant down to 4 K. As a function of C-vacancy concentration in the range x = 0.98-0.90 psisub(1/2) also clearly decreased and then remained approximately constant in the range of x = 0.90-0.82. The C-yield did not depend on the C-concentration. The results of the channeling experiments were interpreted by Monte-Carlo-simulation calculations. A linear increase of the mean static three-dimensional displacements of the Nb-atoms form 0.025 Angstroem to 0.10 Angstroem was found in the concentration range of x = 0.98-0.90 and then the values remained nearly constant in the range of 0.90-0.82. The static displacements of the C-atoms lay below the detection limit of 0.025 Angstroem. The strain field around a vacancy for low vacancy concentrations (x = 0.98-0.96) was calculated employing the Kanzaki-method.

7909 **(KFK—3224) Magnetism of the impurities Gd and Eu in praseodymium.** Goetz, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1). Sep 1981. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750346.

The magnetic properties of dilute PrGd and PrEu alloys were investigated by bulk magnetization measurements in fields up to 6 T and by ^{151}Eu and ^{155}Gd Moessbauer spectroscopy. Both ^{151}Eu and ^{155}Gd Moessbauer spectra exhibit magnetic hyperfine spliting below about 10 K even in the most dilute alloys investigated (approx. <= 1 at%). For concentrations <= 2% Eu, this magnetic splitting is due to slow relaxation of the electronic moment of Eu. From the observed quadrupole splitting of the ^{155}Gd Moessbauer spectra, an estimate for the crystal field parameter B^0_2 in Pr is derived. The magnetic polarization of the Pr ions in a cluster around a Gd moment was calculated impurity is surrounded by an antiparallel polarization cloud; both combine to a small net moment (dwarf moment). These dwarf moments are shown to explain qualitatively the observed difference between the magnetization of the alloys and that of pure Pr at low temperatures.

7910 **(KFK—3313) Burning characteristics of potassium and lithium.** Sonntag, K.; Menzenhauer, P.; Peppler, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Mar 1982. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750976.

A series of laboratory scale tests has been carried out in which lithium and potassium were burnt in trays in atmospheres of air and nitrogen. The test results are compared with those from literature. The maximum weight of metal in a test was 200 gram. The tests were carried out in a glove box which allowed the atomospheric composition to be varied to some extent. The initial temperature was varied to determine its effect on the course of the reaction. The temperature and the composition of the atmosphere were recorded during the tests. After each test the reaction products were weighed and chemically analysed. A good insight into the course of the reaction was obtained from the results. The main phases of the reaction are illustrated by a series of photographs.

7911 (KFK-AFR—003, pp 9) **(n,α) method to determine depth distributions and concentrations of He, Li, and B in solids and semiconductors.** Henkelmann, R.; Jahnel, F. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

7912 (KFK-AFR—003, pp 12) **Continuous monitoring of selective corrosion of steel X2 CrNiSi 18 15 in 98% nitric acid.** Vehlow, J.; Geisert, H. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

7913 **(LBL—14556) Infrared spectra of CO adsorbed at low temperatures on Ni.** Levinson, H.J.; Tobin, R.G.; Richards, P.L. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Physics). Sep 1982. Contract AC03-76SF00098. 7p. (CONF-820977—1). NTIS, PC A02/MF A01. Order Number DE83001568.

From 3. internatonal conference on vibrations at surfaces; Pacific Grove, CA, USA (1 Sep 1982).

At low temperatures (1.5 to 40°K), CO has been found to chemisorb into terminal, bridge, and three-fold sites on evaporated Ni films. The chemisorption takes place directly, rather than through a precursor state. At least two distinct terminal sites are occupied at high coverages. After the sample is warmed from 1.5 to 40°K the infrared spectra change dramatically, showing substantial surface diffusion even at these low temperatures. 4 figures.

7914 **(LBL—14774) High-resolution electron-energy-loss spectroscopy and photoelectron-diffraction studies of the geometric structure of adsorbates on single-crystal metal surfaces.** Rosenblatt, D.H. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Chemistry). Nov 1982. Contract AC03-76SF00098. 206p. NTIS, PC A10/MF A01. Order Number DE83003395.

Thesis. Submitted to the Univ. of California, Berkeley, CA.

Two techniques which have made important contributions to the understanding of surface phenomena are high resolution electron energy loss spectroscopy (EELS) and photoelectron diffraction (PD). EELS is capable of directly measuring the vibrational modes of clean and adsorbate covered metal surfaces. In this work, the design, construction, and performance of a new EELS spectrometer are described. These results are discussed in terms of possible structures of the O-Cu(001) system. Recommendations for improvements in this EELS spectrometer and guidelines for future spectrometers are given. PD experiments provide accurate quantitative information about the geometry of atoms and molecules adsorbed on metal surfaces. The technique has advantages when used to study disordered overlayers, molecular overlayers, multiple site systems, and adsorbates which are weak electron scatterers. Four experiments were carried out which exploit these advantages.

7915 **(NP—3900242) Grinding and friction investigations about the hydrogen embrittlement of iron.** Gidarakos, E. (Hamburg Univ. (Germany, F.R.). Fachbereich Chemie). 23 May 1980. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE83900242.

Thesis.

The crushing behavior of in H_2 tempered (between 773 K and 1173 K) and untempered iron and iron rich solid solutions are investigated in ball mills. Up to 773 K the solubility of H_2 in iron is retarded by an oxid-scale formation. Between 773 K and 1173 K the solving of H_2 is an exothermic reaction. The higher grinding speed shows that the diffusing H_2 embrittles the iron. When the grinding runs in an H_2-atmosphere additional H_2 diffuses into the ruptured crystals. As a consequence the embrittlement and the grinding speed is increasing. Theoretical reflection show that the high local temperature (ca. 1773 K) during the grinding process (friction heating) is responsible for the high H_2-solubility. The rewelding of the crushed material is retarded by adding Octan and Xylol.

7916 **(ORNL/TM—8392) Response of bainitic 2 1/4 Cr-1 Mo steel to creep-fatigue loadings at 482°C.** Swindeman, R.W.; Strizak, J.P. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE83003195.

Creep-rupture, fatigue, and creep-fatigue tests were performed on 150-mm plate of bainitic 2 1/4 Cr-1 Mo steel at 482°C. Purpose was to produce exploratory data to assess the sensitivity of the material to time-dependent damage processes. Two material conditions were examined - quenched and tempered (QT) for 6 h at 662°C and simulated postweld heat treated (PWHT) for 28 h at 690°C. Continuous-cycling fatigue data for the PWHT material revealed better fatigue resistance than reported in the literature. Under creep-fatigue conditions, with relaxation hold times in the range 0.01 to 0.5 h, the fatigue strength was substantially reduced. The PWHT material exhibited slightly poorer fatigue properties under tensile relaxation holds than under compression holds at the 1% strain range level. This behavior pattern is the opposite of the trend reported for annealed 2 1/4 Cr-1 Mo steel and suggests that the mechanism of damage accumulation in this class of material may depend on strain range and microstructure as well as environmental conditions. However, the failure mode for bainitic material was similar to that reported for ferritic (annealed) material. 10 figures, 4 tables.

7917 **(PB—82-204645) Effect of sensitization and cold work on stress corrosion susceptibility of austenitic stainless steels in BWR and PWR conditions.** Haenninen, H.; Aho-Mantila, I. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). May 1981. 69p. NTIS, PC A04/MF A01.

The influence of metallurgical variables on stress corrosion cracking of austenitic stainless steels, in particular AISI 304 and OX18H10T, has been examined both in O2-enriched BWR-conditions (8 ppm O2) and in typical PWR-conditions.

7918 **(PB—82-206376) Reactor pressure vessel steels ASTM A533B and A508 c1.2: crack opening displacement (COD) test results.** Pelli, R.; Kemppainen, M.; Toeroenen, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). Jun 1980. 22p. NTIS, PC A02/MF A01.

This report describes the crack opening displacement (COD) test results for the steels ASTM A533B and A508 C1.2 obtained in connection with a program initiated to gather and create information concerning the manufacturing variables, e.g. heat treatment, needed in the assessment of the structural integrity of reactor pressure vessels. The elastic-plastic fracture toughness was studied after applying various austenitizing and tempering temperatures.

7919 **(RISO-M—2288) Studies on hydrogenation properties of the intermetallic compound FeTi.** Schroeder Pedersen, A. (Risoe National Lab., Roskilde (Denmark)). Dec 1981. 103p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750335.

The literature on hydrogen uptake in FeTi has been briefly reviewed, and the most important uptake data are given. Samples of FeTi have been activated, and the specific surface areas determined using the BET model. Activaton seems to imply a specific surface area of about 0.5 m^2/g independing on the initial mean particle size. The hydrogen uptake in FeTi at low pressures (0-1000 torr) has been studied at low temperatures (80-90 K) and in the 300-500 K range. At low temperatures a dissociative, non-activated Temkin adsorption process is found. In the high temperature range a dissolution is dominating, and diffusion seems to be the rate limiting step. A measured value of the activation energy for diffusion is given. Data on the hydrogen adsorption in the α-β equilibrium range are given. The data suggest that one well defined process determines the rate of absorption. The uptake isotherm deviates somewhat, from what has been reported earlier.

7920 **(SAND—82-1627C) Microstructure and mechanical properties of precipitation-hardened aluminum under high rate deformation.** Grady, D.E.; Asay, J.R.; Rohde, R.W.; Wise, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 14p. (CONF-820725—3). NTIS, PC A02/MF A01. Order Number DE83002870.

From 29. annual Sagamore Army materials research conference; Lake Placid, NY, USA (19 Jul 1982).

In recent years the shock deformation properties of a precipitation-hardened aluminum alloy (6061-T6) have been investigated extensively with time-resolved wave-profile gauges. Studies have revealed complicating features of the shock-deformation process not easily explained by existing theories of plastic deformation. Specifically, unusual behavior in the dynamic hardness or strength, post-shock hardness, steady wave viscosity, and post-shock microstructure has been observed over the shock pressure range of 1 to 15 GPa. The deformation structure suggests that microscopic heterogeneity in the deformation and temperature state during dynamic compression may be responsible for the observed effects. We have undertaken a study to correlate the shock compression and quasistatic deformation of 6061-T6 aluminum. Recovered specimens which have been shock loaded are examined metallurgically, and results are compared with both static and dynamic mechanical-property measurements. Illuminating correlations are emerging from this study, although an unambiguous determination of the importance of heterogeneous effects is yet to be achieved. A modeling effort of dynamic deformation in aluminum based on heterogeneous deformation and adiabatic thermal trapping is being pursued. 7 figures.

7921 **(UCID—19581) Determination of yield strength (Y^0) for ballistically impacted cylinders of beryllium.** Honodel, C.A. (Lawrence Livermore National Lab., CA (USA)). 19 Oct 1982. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01. Order Number DE83002460.

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Two Be materials were added to the table of projectile materials. The resulting Y^0 values varied from 0.0062 to 0.0101. 8 figures, 1 table. (DLC)

7922 **(UCID—19600) Bellows-welding study.** Faulkner, G.E.; Westrich, C.N. (Lawrence Livermore National Lab., CA (USA)). 8 Nov 1982. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01. Order Number DE83003056.

Standing lip welds in circular discs of 0.005 in. thick Type 304L stainless steel were gas tungsten arc welded to investigate low fatigue life in welded bellows. Eleven variables, such as arc gap, alignment of the tungsten with the weld centerline, mismatch, etc., which are encountered in production welding, were simulated to study their effects on weld penetration. Weld current and arc voltage were monitored to determine if they were sensitive to variables that resulted in unacceptable weld penetration. The study was performed to minimize random variables. Precision chills were used to obtain uniform weld chill. A jewelers lathe was used to provide weld travel. A live center in the tail stock of the lathe was used to apply chill pressure. A microscope was used to align the tungsten electrode with the joint and to observe the weld. A welding power source, with precise control of welding current was used. Discs were deburred. Eight cross sections were examined to measure weld penetration. Weld penetration values varied considerably within individual welds. Minimum values were 25 to 50% lower than maximum values. Also photographs of weld cross sections from fatigue tested bellows were examined to measure weld penetration. The range of penetration values from these bellows was the same as found within individual welds. Variable weld penetration was attributed to variable weld chill and arc wander. An attempt was made to study the effects of weld chill, and a trend was observed. No attempt was made to study arc wander, but it appeared to be less in the last series with burr-free discs. Weld current arc voltage could not be correlated with production variables or variable penetration.

7923 **(UCRL—88199) Surface preparation and plating.** Dini, J.W.; Waldrop, F.B.; Reno, R.W. (Lawrence Livermore National Lab., CA (USA); Oak Ridge Y-12 Plant, TN (USA)). 6 Oct 1982. Contract W-7405-ENG-48. 54p. (CONF-820159—1). NTIS, PC A04/MF A01. Order Number DE83001190.

From Society of Photo Optical Instrumentation Engineers advanced seminar institute on diamond turning; Pajara Dunes, CA, USA (1 Jan 1982).

Portions of document are illegible.

This chapter covers electroplating and electroless nickel plating since coatings of this type play an important role in diamond turning technology. Items to be discussed include preparation of substrates prior to coating, plating defects such as pits and nodules and their influence on optics, the influence of stress in coatings, plating details for copper, gold, silver, and electroless nickel, and the importance of additives and their influence on grain size and structure of deposits. Some comments are made on future challenges that could be presented to the plating community to further improve the quality of coatings applied for diamond turning purposes. 60 references, 8 figures, 9 tables.

7924 **Flow localization and shear band formation in a precipitation strengthened austenitic stainless steel.** Mataya, M.C.; Carr, M.J.; Krauss, G. (Rockwell Int, Golden, CO, USA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **13A**: No. 7, 1263-1274(Jul 1982).

Flow localization and shear band formation in a /gamma/ sub p/rime/ strengthened austenitic stainless steel, JBK-75, was investigated by compression of reduced-gage-section, cylindrical specimens deformed in a strain rate range of 10/sup 3/ to 10/sup -3/s/sup -1/ and from 650/degree/C to 1100/degree/C. Localized flow was always associated with dynamic recrystallization. Other mechanisms for flow localization, including the effects of adiabatic heating on /gamma/sub p/rime/ precipitate dissolution, are discussed. 20 refs.

7925 **Intrinsic diffusion coefficients and the vacancy flow factor in dilute Cu-Zn alloys.** Hoshino, K.; Iijima, Y.; Hirano, K. (Argonne Natl Lab, IL, USA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **13A**: No. 7, 1135-1139(Jul 1982).

The interdiffusion coefficient and the intrinsic diffusion coefficient of Zn and Cu in dilute alloys at 1168 K have been determined with semi-infinite couples using Darken's relation. In addition, the Kirkendall effect in thin plate couples at 1168 K has been examined using Heumann's method to determine the ratio of the intrinsic diffusion coefficients in very dilute alloys. The correlation factor for impurity diffusion of zinc in copper has been estimated by combining the vacancy flow factor with the enhancement

factor. This permits an estimate of the kinetic energy factor for impurity diffusion. 26 refs.

7926 **Hydrogen transport in nickel base stainless alloys.** Mezzanotte, D.A.; Kargol, J.A.; Flore, N.F. (Univ of Notre Dame, Indiana, USA). *Metallurgical Transactions. [Section] A: Physical Metallurgy and Materials Science;* **13A**: No. 7, 1181-1186(Jul 1982).

Hydrogen transport parameters have been measured in HASTELLOY Alloys C-276 and over the temperature range of 17 to 90/degree/C. The two alloys exhibited dramatically different hydrogen behavior. For Alloy C-276, diffusivity in both the cold worked and annealed conditions decreased by a factor of two following low temperature (500/degree/C) aging. Hydrogen trapping was not observed. An analysis of hydrogen transport in Alloy G indicated reversible and irreversible trapping by niobium substitutional atoms and second phase carbides, respectively. The results are related to hydrogen embrittlement tendencies. 37 refs.

7927 **Metallurgical instabilities in a 50% Ag-50% Pd alloy.** Williams, R.K. (Oak Ridge Natl Lab, TN, USA). *Scripta Metallurgica;* **16**: No. 6, 683-686(Jun 1982).

The author gives data on short range ordering, the effect of room temperature deformation by swaging, isochronal recovery, and the effect of annealing temperature on the electrical resistivity of a fully recrystallized specimens. 16 refs.

7928 **High-power laser and arc welding of thorium-doped iridium alloys.** David, S.A.; Liu, C.T. (Oak Ridge Natl Lab, TN, USA). *Welding Journal (Miami);* **61**: No. 5, 157(May 1982).

The arc and laser weldabilities of two Ir-0.3% W alloys containing 60 and 200 wt-ppm Th have been investigated. The Ir-0.3% W alloys doped with about 60 wt-ppm Th are used as post-impact containment material for radioactive fuel in thermoelectric generators that provide electrical power for outer planetary missions. 18 refs.

7929 **Peg formation by short-circuit diffusion in Al_2O_3 scales containing oxide dispersions.** Hindam, H.; Whittle, D.P. (Univ of CA, Berkeley, USA). *Journal of the Electrochemical Society;* **129**: No. 5, 1147-1151(May 1982).

It is well-established that the addition of active elements (Y, Ce, Hf, Th, etc.) or dispersoids of the respective oxide phases improves the oxidation behavior of Cr/sub 2/O/sub 3/- and Al/sub 2/O/sub 3/-forming alloys and coatings. The formation of inwardly growing oxide pegs mechanically keys the scale to the substrate. Recent observations are hereby presented, and a mechanism for peg formation is advanced. 10 refs.

7930 **Formation of high angle grain boundaries during the deformation of aluminum single crystals.** Chandra, H.; Embury, J.D.; Kocks, U.F. (McMaster Univ, Hamilton, Ontario, Canada). *Scripta Metallurgica;* **16**: No. 5, 493-497(May 1982).

Large local misorientations arise due to the sequence of slip systems which are active in a given region during deformation. 17 refs.

7931 **Activation energy of superplastic deformation of a microduplex steel by differential temperature tests.** Kashyap, B.P.; Mukherjee, A.K. (Univ of California, Davis, USA). *Scripta Metallurgica;* **16**: No. 5, 541-546(May 1982).

In IN744 steel the activation energy of superplastic deformation Q?187.14/plus or minus/8.27 kJ/mole is representative of deformation in the pseudo-steady state and is comparable with the grain boundary diffusion of Fe, Cr and Ni in Fe-Cr-Ni stainless steels. However, under conditions of unstable microstructures and/or strain sensitive flow, the activation energy may be higher or lower than the value of Q corresponding to the onset of plastic strain depending on the contribution of strain softening and hardening. 16 refs.

7932 **Comparison of segregated phosphorus and sulfur effects on the fracture mode and ductility of iron tested at cathodic potentials.** Jones, R.H.; Bruemmer, S.M.; Thomas, M.T.; Baer, D.R. (Battelle, Pac Northwest Lab, Richland, WA, USA). *Scripta Metallurgica;* **16**: No. 5, 615-620(May 1982).

Specimens of Fe, Fe+1000 appm P and Fe+1000 appm P+800 appm Mn were evaluated. A grain boundary phosphorus concentration of 0.2 monolayers was insufficient to promote intergranular fracture. This is in contrast to the effect of sulfur where grain boundary concentraions exceeding 0.13 monolayers caused 100% fracture. Phosphorus competes with and reduces grain boundary sulfur segregation and has a beneficial effect on ductility. 10 refs.

7933 **TEM observations of the motion of crack tip-produced dislocations during cyclic loading in aluminum.** Horton, J.A.; Ohr, S.M. (Oak Ridge Natl Lab, TN, USA). *Scripta Metallurgica;* **16**: No. 5, 621-626(May 1982).

Under a high vacuum, some dislocations which were emitted from crack tip during tensile loading returned to the crack tip as the load was reduced. As the load was increased again, the dislocations were re-emitted and moved away from the crack tip along the same slip plane. 17 refs.

7934 **Defect clustering induced by secondary collisions in Pt(C) alloys during high-voltage-electron-microscope irradiation.** Regnier, P.; Lam, N.Q.; Westmacott, K.H. (Argonne Natl Lab, IL, USA). *Scripta Metallurgica;* **16**: No. 5, 643-648(May 1982).

Electrons can transfer more energy to the C atoms than to the Pt atoms. The formation of interstitial dislocation loops proves that the effects of secondary C-Pt collisions are important. 8 refs.

7935 **Fatigue crack propagation through inelastic gradient fields.** Leis, B.N. (Battelle, Columbus Lab, Ohio, USA). *International Journal of Pressure Vessels and Piping;* **10**: No. 2, 141-158(Mar 1982).

This paper examines the growth rate behavior of cracks growing in the inelastic gradient field of a notch for a range of crack sizes, stress levels and notch severities. Experimental data used as a vehicle to explore the utility of K as a correlating parameter show that linear elastic fracture mechanics (LEFM) errs significantly. The significance of these errors is discussed with regard to current code specified procedures based on LEFM, whose use to calculate in-service inspection intervals in ductile piping systems may lead to non-conservative estimates. 23 refs.

7936 **Swelling, microstructural development and helium effects in type 316 stainless steel irrediated in HFIR and EBR-II.** Maziasz, P.J.; Grossbeck, M.L. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 987-992(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

This work examines the swelling and microstructural development of a single heat of 20%-cold-worked type 316 stainless steel irradiated to produce displacement damage and a high, continuous helium generation rate, in the High Flux Isotope Reactor (HFIR). Similar irradiation of the same heat of steel in the Experimental Breeder Reactor (EBR)-II is used as a base line for comparing displacement damage accompanying a very low continuous helium generation rate. At temperatures above and below the void swelling regime (approx. equal to 350 to 625°C) swelling is greater in HFIR than in EBR-II. In the temperature range of 350 to 625°C, cavity formation, precipitation and dislocation recovery are both enhanced and accelerated in HFIR, often causing swelling at lower dose than in EBR-II. In HFIR, however, cavities appear to be bubbles rather than voids. They are about 10 times smaller and 20 to 50 times more numerous than voids in EBR-II. Thus, the swelling becomes greater in EBR-II than in HFIR for 20%-CW 316 in the void swelling temperature ranges as fluence increases. Such differences in swelling and microstructural behavior must be understood in order to anticipate the behavior of materials during fusion irradiation.

7937 **Comparison of the swelling and the microstructural/microchemical evolution of AISI 316 irradiated in EBR-II and HFIR.** Brager, H.R.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 993-998(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The microstructural and microchemical evolution has been compared for one heat of cold worked 316 stainless steel irradiated in both HFIR and EBR-II at 500-620°C. The dislocation and cavity densities and the swelling at high fluence are remarkably insensitive to the over two orders of magnitude differences in helium/dpa ratios. While the microchemical evolution is also largely unaffected, minor differences were observed possibly arising from solid transmutants that form only in HFIR. The reported absence of γ' phase in specimens irradiated in HFIR at these temperatures reflects its sluggish formation in both reactors. The microchemical evolution is accompanied by the development of a swelling rate typical of steels irradiated in fast reactors. The magnitude of this swelling rate is corroborated by HFIR data on this same heat in the solution annealed condition.

7938 **Effect of solid transmutation products on swelling in 316 stainless steel.** Bates, J.F.; Garner, F.A.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 999-1004(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Application of the extensive data base developed in fission reactors to the design of fusion reactors requires an understanding of the differences in the characteristics of the two neutron spectra. This paper presents the results of a study in which the isotopic evolution of AISI 316 was calculated for two breeder reactors, two fusion devices and the High Flux Isotope Reactor (HFIR). The largest changes in composition arise in HFIR, where the manganese is strongly depleted and substantial vanadium is generated. Both of these elements increase in fusion reactors but much more slowly. Data on the manganese dependence of swelling in AISI 316 is presented to show that depletion of manganese in HFIR may lead to changes in the swelling behavior. Swelling may also be altered by vanadium in a manner typical of other strong MC-carbide forming elements such as titanium.

7939 **Effects of pulsed dual-ion irradiation on microstructural development.** Packan, N.H. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1029-1034(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The effect of pulsed irradiation on the development of microstructure during Ni ion bombardment has been investigated in a simple austenitic alloy similar to type 315 stainless steel. Bombardment conditions were 10 dpa, 940 K, pulsing with equal on/off times of either 0.5 or 60 s, and the addition of 20 appm He/dpa to some specimens either by room temperature preimplantation or by dual-beam coimplantation. Particular care was taken to minimize thermal pulses from beam heating (to < 2°C). The results show that pulsing has a subtile influence, and the effects on specific cavity parameters are complex. Pulsing produced a small increase in swelling in the helium-free case, but a slight decrease for helium-implanted specimens, and it seems to have counteracted the usual stimulative effects of helium on cavity nucleation. An assessment is made of the often-conflicting observations in the literature; there is a need for further, well-controlled experiments.

7940 **Influence of helium injection rate on the microstructure of dual-ion irradiated type 316 stainless steel.** Ayrault, G.; Hoff, H.A.; Nolfi, F.V. Jr.; Turner, A.P.L. (Argonne National Lab., IL (USA). Materials Science Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1035-1040(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Type 316 stainless steel in a solution annealed and aged condition has been dual-ion irradiated with Ni^+ and He^+ and the resulting microstructure investigated with TEM. Dose dependence studies (3-25 dpa at 625°C and 3×10^{-3} dpa x s^{-1}) were performed at three helium injection rates (5, 15 and 50 appm He/dpa). Bimodal cavity-size distributions formed at all three helium injection rates; both large- and small-cavities in the distributions were preferentially associated with $<100>$ acicular precipitates. The 5 and 15 appm He/dpa irradiations produced similar microstructures and swelling (approx. equal to 1.2% at 28 dpa), but higher cavity number densities in 50 appm He/dpa samples produced greater swelling (approx. equal to 1.5% at 20 dpa) despite smaller mean cavity sizes.

7941 **Damage structure in nimonic PE16 alloy ion bombarded to high doses and gas levels.** Farrell, K.; Packan, M.H. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1059-1062(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The Nimonic PE16 alloy in solution-treated-and-aged condition was bombarded simultaneously with nickel ions and α and deuteron beams at 625°C to doses of 80 to 313 dpa at He/dpa = 10 and D/dpa = 25. Microstructural changes consisted of the introduction of dislocations and of cavities, and the redistribution of γ' precipitates to these defects. Cavitational swelling remained below 1%. Cavities were represented by several distinct size classes, the smaller ones believed to be gas bubbles, and some larger ones associated with preferred growth of precipitates. Formation of bubbles at grain boundaries, and large cavities at incoherent twins intensified the possibility of mechanical separation of interfaces under high-gas irradiation conditions.

7942 **Void swelling in the molybdenum alloy TZM irradiated to high fluence.** Gelles, D.S.; Peterson, D.T.; Bates, J.F. (Hanford Engineering Development Lab., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1141-1146(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Microstructural development and density change measurements are reported for TZM, a commercial molybdenum base alloy, following fast neutron irradiation in EBR-II to high fluence over the temperature range 400 to 650°C. Uniformly distributed voids arrayed in a lattice and constituting 3% swelling were observed following irradiation at 650°C to 1.47×10^{23} n/cm^2 ($E > 0.1$ MeV) (53 dpa). Nonuniformly distributed rafts of voids in lattice arrays were observed following irradiation at 540°C to 1.36×10^{23} n/cm^2. Void swelling was not resolved following irradiation at 425°C to 1.22×10^{23} n/cm^2. Void swelling measurements corroborated density change results which showed peak void swelling behavior saturating at 590°C. Two mechanisms for the behavior observed are considered; the first is based on an apparent maximum void size of 10 nm which leads to void rafting and eventually to void swelling saturation. Saturation is predicted only after 10^{24} n/cm^2 (360 dpa) with 20% swelling possible. The second mechanism considers the effect of a developing void lattice on dislocation dynamics.

7943 **Exact calculations of nuclear recoil energies from prompt γ decays resulting from neutron capture.** Kinney, J.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; California Univ., Davis (USA). Materials Science Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1331-1336(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The results of a determination of the recoil spectrum from (n, γ) reactions in molybdenum using available nuclear data are presented in this paper. The recoil spectrum has been calculated from nuclear level structure data and measured branching ratios. Angular correlations between successive gammas have been accounted for using the standard theoretical techniques of Racah algebra and the density matrix formalism. The shortcomings of these calculations are discussed, and a method is proposed to overcome them.

7944 Radiation induced segregation in candidate fusion reactor alloys. Brimhall, J.L.; Baer, D.R.; Jones, R.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1379-1384(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The effect of radiation on surface segregation of minor and impurity elements has been studied in four candidate fusion reactor alloys. Radiation induced surface segregation of phosphorus was found in both 316 type stainless steel and in Nimonic PE-16. Segregation and depletion of the other alloying elements in 316 stainless steel agreed with that reported by other investigators. Segregation of nitrogen in ferritic HT-9 was enhanced by radiation but no phosphorus segregation was detected. No significant radiation enhanced or induced segregation was observed in a Ti-6Al-4V alloy. The results indicate that radiation enhanced grain boundary segregation could contribute to the embrittlement of 316 SS and PE-16.

7945 Effect of precipitate-matrix interface sinks on the growth of voids in the matrix. Brailsford, A.D.; Mansur, L.K. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.; Ford Motor Co., Dearborn, MI (USA). Engineering and Research Staff). *Journal of Nuclear Materials;* **104**: No. 1-3, 1403-1408(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

A qualitative discussion of the differing roles played by coherent and incoherent precipitates as point defect sinks is presented. Rate theory is used to obtain semiquantitative estimates of the growth of cavities in the matrix when either type of precipitate is present. Methods for deriving the sink strengths of precipitates of arbitrary shape are developed. In three materials where available microstructural information allows an analysis, precipitates are found to cause only a small relative suppression of cavity growth via the mechanisms here considered.

7946 Effect of cyclic pulsed temperature on void growth in metals during irradiation. Kmetyk, L.N.; Sommer, W.F.; Weertman, J. (Los Alamos Scientific Lab., NM (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1409-1414(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The analysis of Brailsford and Bullough on radiation-produced point defect transport to lattice sinks and the analysis of Ghoniem and Kulcinski of pulsed radiation have been extended to include the effects of radiation-induced temperature oscillations. We have already shown in earlier papers that these temperature pulses enhance void growth if the ambient in earlier papers that these temperature pulses enhance void growth if the ambient temperature is below the peak swelling temperature and, conversely, decrease void growth when the ambient temperature is above the peak swelling temperature. When the temperature pulses were suppressed, no difference was seen between void growth under steady and pulsed irradiation. In this paper, we show that the same effects on void growth can be obtained by superposing externally-produced temperature pulses on material under steady irradiation. Calculations have been done for aluminum and molybdenum for sinusoidal temperature pulses of many amplitudes and frequencies.

7947 Spectral tailoring for fusion radiation damage studies: Where do we stand. Gabriel, T.A.; Lillie, R.A.; Thoms, K.; Childs, R.L. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1445-1450(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The Oak Ridge Research is currently being used to irradiate an experiment (MFE-4A) to simulate in stainless steel-316 the He-to-DPA ratio of 14 appm He/DPA expected at the first wall of a fusion reactor. The experimental design criterion is to remain within +- 20% of this ratio after an initial irradiation period of approx. equal to 1.2 years. At present (March 31, 1981) the experiment has been in the reactor for 19 cycles corresponding to 131,543 MWh, 4.05 x 10^{25} n/m^2 in thermal fluence, 1.21 x 10^{26} n/m^2 in total fluence, 3.1 DPAs and 21.0 appm He. The current He-to-DPA ratio is 6.8. This paper summarizes some of the analytical calculations for this experiment and presents the current status of this work. The analytical calculations utilize the codes VENTURE, ANISN, GAS, UNFOLD, etc. and the obtained results include gas production, DPA, and heating rates, and neutron spectral modification resulting from different reactor fuel loadings and core piece compositions.

7948 Precipitation and cavity formation in austenitic stainless steels during irradiation. Lee, E.H.; Rowcliffe, A.F.; Mansur, L.K. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1475-1480(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Microstructural evolution in austenitic stainless steels subjected to displacement damage at high temperature is strongly influenced by the interaction between helium atoms and second phase particles. Cavity nucleation occurs by the trapping of helium at partially coherent particle-matrix interfaces. The recent precipitate point defect collector theory describes the more rapid growth of precipitate-attached cavities compared to matrix cavities where the precipitate-matrix interface collects point defects to augment the normal point deflect flux to the cavity. Data are presented which support these ideas. It is shown that during nickel ion irradiation of a titanium-modified stainless steel at 675°C the rate of injection of helium has a strong effect on the total swelling and also on the nature and distribution of precipitate phases.

7949 Swelling of $^{58}Ni^+$ and $^3He^+$ ion-irradiated Nb and Nb alloys. Loomis, B.A.; Gerber, S.B. (Argonne National Lab., IL (USA). Materials Science Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1193-1198(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

The swelling of ion-irradiated Nb alloys has been studied experimentally by transmission electron microscopy. Binary alloys containing 0.01-0.4 a/o O, 2.3 a/o Ti, Ni, Mo or Fe, and a ternary alloy containing 2.5 a/o Mo and 2.5 a/o Hf, have been examined. The swelling during 3.0-MeV $^{58}Ni^+$ ion irradiation results from void formation; the swelling produced during simultaneous 3.0-MeV $^{58}NI^+$ and 0.87-MeV $^3He^+$ ion irradiation results from cavity formation. The experimental results are interpreted to show that the void or cavity volume fraction is significantly reduced by Ti or Mo additions to Nb but is not influenced by Ni or Fe additions.

7950 Resistance of $(Fe,Ni)_3V$ long-range-ordered alloys to neutron and ion irradiation. Braski, D.N. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1199-1204(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

A series of $(Fe,Ni)_3V$ long-range-ordered alloys were irradiated with neutrons in the Oak Ridge Research Reactor (ORR) and with 4 MeV Ni ions at temperatures above 250°C. The displacement damage levels for the two irradiations were 3.8 and 70 dpa, and the helium levels were 29 and 560 at. ppm, respectively. Irradiation in ORR generally increased the yield strength and lowered the ductility of an LRO alloy, but produced relatively little swelling. The LRO alloys retained their long-range order after ion irradiation below the critical ordering temperature, Tsub(c), and exhibited low swelling. Above Tsub(c) the alloys were disordered and showed greater swelling. Adjustment of alloy composition to prevent sigma phase formation reduced swelling.

7951 Fusion neutron disordering of Cu_3Au. Guinan, M.W.; Kinney, J.H.; Van Konynenburg, R.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.); Damask, A.C. (Queens Coll., New York (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1217-1220(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

We have measured the disordering rate of highly-ordered Cu_3Au (S=.99) at 4 K during irradiation with 14.8 MeV neutrons at RTNS-II. The rate was measured by monitoring changes in resistivity. The disordering rate was found to be 15.7 x 10^{-20} cm^3/n.

The analysis of the results and a comparison with fission reactor irradiations indicate that the disordering rate in Cu_3Au scales with damage energy. This is in agreement with observations made on long-range ordered A15 superconducting compounds.

7952 **Depth distribution of 20-keV helium irradiation induced cavities in nickel.** Fenske, G.; Das, S.K.; Kaminsky, M. (Argonne National Lab., IL (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1231-1236(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Transmission electron microscopy has been used to study the effect of total dose on the depth distribution of cavities (voids or bubbles) in nickel irradiated at 500°C with 20-keV $^4He^+$ ions. A transverse sectioning technique allowed us to obtain the entire depth distribution of cavities from a single specimen. The diameter, number density and volume fraction of cavities were measured as a function of depth from micrographs taken from samples sectioned parallel to the direction of the incident beam. The results for the doses at 2.9×10^{15} and 2.9×10^{16} ions/cm^2 show an increase in the average cavity diameter, number density and volume fraction with increasing dose. A further increase in dose from 2.9×10^{16} to 2.9×10^{17} ions/cm^2 also shows an increase in the average cavity diameter but a decrease in the number density. This observation is interpreted as evidence for the coalescence of cavities.

7953 **Stress dependence of creep in Ni bombarded with 17 MeV deuterons.** Henager, C.H. Jr.; Simonen, E.P.; Bradley, E.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)); Stang, R.G. (Washington Univ., Seattle (USA). Dept. of Mining, Metallurgical and Ceramic Engineering). *Journal of Nuclear Materials;* **104**: No. 1-3, 1269-1274(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

A linear stress dependence of irradiation creep was observed in pure, heavily coldworked Ni and the creep behavior was modeled using a climb-glide creep mechanism. The Ni foils were bombarded with 17 MeV deuterons at 473 K with a damage rate of 6×10^{-7} dpa/s. The applied tensile stress ranged from 135 MPa. Transmission electron microscopy revealed that up to 50% of the material had recrystallized during the pre-irradiation thermal creep test. A high number density of interstitial loops were observed throughout the material. Small voids were observed primarily in the recrystallized regions. The creep rate magnitude and stress dependence was rationalized using models of loop hardening and rate theory predictions of point defect annihilation at sinks.

7954 **Irradiation creep in simple binary alloys.** Nagakawa, J.; Sethi, V.K.; Turner, A.P.L. (Argonne National Lab., IL (USA). Materials Science Div.). *Journal of Nuclear Materials;* **104**: No. 1-3, 1275-1280(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Creep enhancement during 21 MeV deuteron irradiation was examined at 350°C for two simple binary alloys with representative microstructures, i.e. solid solution (Ni - 4 at.% Si) and precipitation hardened (Ni - 12.8 at.% Al) alloys. Coherent precipitates were found to be very effective in suppressing irradiation enhanced creep. Si solute atoms depressed irradiation creep moderately and caused irradiation hardening via radiationinduced segregation. The stress-dependence of irradiation creep in Ni - 4 at.% Si showed a transition, which seems to reflect a change of mechanism from dislocation climb due to stress-induced preferential absorption (SIPA) to climb-controlled dislocation glide enhanced by irradiation.

7955 **Pulsed irradiation creep in nickel.** Simonen, E.P.; Henager, C.H. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1281-1286(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Results from a series of pulsed irradiation creep tests have indicated a significant effect of beam heating on pulsed irradiation creep behavior. A pulsing effect due to intermittent atomic displacement damage was not observed. Sheet metal specimens were irradiated at 473 K using 15 MeV deuterons and a stress of 200 MPa. The pulse cycle consisted of 1000 seconds of irradiation followed by 100 seconds of annealing. Pulsed irradiation creep behaviour was compared with steady irradiation creep behavior. The experimental results were interpreted using models of intermittent displacement damage and theories of temperature history effects.

7956 **Effects of ferrite content in austenitic stainless steel welds.** Hauser, D.; Vanecho, J.E. (Battelle, Columbus Lab, Ohio, USA). *Welding Journal (Miami);* **61**: No. 2, 37(Feb 1982).

The effects of delta ferrite level on tensile and creep-rupture behavior of E308-16 shielded metal-arc stainless steel weld metal were determined. Most of the creep-rupture tests were conducted at 1000 and 1200°F so that the results could be compared with prior results of tests conducted at 1100°F. The data obtained included initial and final elongation, rupture time, reduction of area, minimum creep rate, time to attain 0.5, 1.0, and 10% creep strain, and the strain and time to the initiation of third stage creep. 12 refs.

7957 **Effects of morphology on the mechanical behavior of a dual phase Fe/2Si/0.1C steel.** Kim, N.J.; Thomas, G. (Lawrence Berkeley Lab., CA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **12**: 483-489(Mar 1981). Contract W-7405-ENG-48.

A study has been made on the effects of morphology on the mechanical behavior of a dual phase Fe/2Si/0.1C steel. The coarse dual phase structure obtained by continuously annealing in the two phase region directly from the austenite region results in poor elongation ductility with relatively high strength. However, upon obtaining a fine fibrous or fine globular dual phase structure by following different transformation paths, significant improvements occur in elongation ductility without much sacrifice in strength. The poor elongation ductility of the coarse dual phase structure is due to the initiation of cleavage cracks in the ferrite region where maximum localized stress concentration took place. But, in steels with both fine fibrous or globular morphologies, fracture occurred by void nucleation and coalescence after large amounts of plastic deformation.

7958 **An internally consistent model for radiation-induced void swelling.** Nichols, F.A.; Liu, Y.Y. (Argonne National Lab., IL). *American Society for Testing and Materials, Special Technical Publication;* **725**: 145-165(1981).

Most previous analytical models for radiation-induced void swelling employed reaction rate theory in which all concentrations were "averaged out." The loss terms for use in such models were then usually obtained by separate, single-cell diffusion analyses which introduced various inconsistencies and uncertainties. Presented here is a unified, internally consistent analytical approach which incorporates, for the first time, the presence of dislocations, voids, and grain boundaries each with their own spatially varying diffusional fields. The results show large variations in sink strength Z-factors, usually treated as constants, significant variations in the void swelling bias factor, and quantitative levels of bias about an order of magnitude larger than most previous estimates. Good qualitative agreement is shown with available data, consistent with current concepts of close-pair annihilation in high-energy damage cascades.

7959 **Neutron scattering studies of quasi one- and two-dimensional hydrogen-bonded ferroelectrics.** Youngblood, R.W. (Brookhaven National Lab., Upton, NY). *Ferroelectrics;* **35**: 73-81(1981).

This work reviews neutron scattering studies of cooperative ordering in the hydrogen bond networks of stannous chloride dihydrate (SCD) copper formate tetrahydrate (CPT) and cesium dihydrogen phosphate (CDP). In each case, there is an interesting nontrivial comparison to be made with an exactly solvable lattice model.

7960 **Embrittlement of steels by hydrogen sulfide.** Sieradzki, K. (Ames Lab., IA). *Scripta Metallurgica;* **15**: No. 2, 171-176(1981).

Results of fracture toughness testing of specimens of 4340 steel as a function of H_2S gas pressure are presented. Observations

indicated a delayed crack tip plasticity effect caused by the H_2S gas. Evidence is presented that indicated that the cracking initiated at the fatigue precrack proceeded in the form of a tunnel crack configuration and that the crack tunneling left strips of material along each edge ~ 10^{-4} m in width which finally underwent a tearing or collapse. This strip collapse appeared to result in plastic zone growth under static load in H_2S. (BLM)

7961 **Growth and thermal stability of single crystal metastable semiconducting (GaSb)/sub 1-x/Ge/sub x/ films.** Cadien, K.C.; Eltoukhy, A.H.; Greene, J.E. (Univ. of Illinois, Urbana). *Vacuum;* **31**: No. 6, 253-258(1981).

Epitaxial metastable (GaSb)/sub 1-x/)Ge/sub x/ alloys with compositions across the pseudobinary phase diagram have been grown on (100) GaAs substrates by multitarget rf sputtering. The maximum growth temperature T/sub s/ ranged from 490 to 520°C depending on the alloy composition. An essential feature allowing the growth of these metastable materials was low energy ion bombardment of the growing film during deposition to enhance surface diffusion, promote mixing, and preferentially sputter incipient second phase precipitates. A phase map plotted as a function of T/sub s/ showed a very narrow transition region between metastable single phase alloys and equilibrium two phase structures. Annealing experiments indicated that the metastable films exhibit good high temperature stability and that they transform through a continuous series of GaSb-rich and Ge-rich phases in which the solute concentrations decrease until the equilibrium two phase alloy is obtained. While the calculated free energy difference between the single phase metastable and equilibrium states is ~ 18 MeV atom^{-1}, the measured activation barrier for the transformation is ~ 3 eV. All films were p-type with room temperature hole concentrations varying from 10^{16} to 10^{19} cm^{-3} and mobilities between 10 and 720 cm^2/V-s, depending on film composition.

7962 **Study of oxide formation on (001), (011), (111), and (113) surfaces of Cr thin films using stem-microdiffraction methods.** Watari, F.; Cowley, J.M. (Arizona State Univ., Tempe). *Surface Science;* **105**: 240-264(1981). Contract AC02-76ER02995.

The process of oxidation on the surfaces of thin Cr films with (001), (011), (111), and (113) orientations, prepared by evaporation, has been studied by use of a scanning transmission electron microscopy (STEM) instrument. Micro-diffraction patterns observed by use of an optical image analyzer attachment permit the identification of oxide phases and reveal their epitaxial relationship to the Cr substrate. A spinel-like oxide grows as a thin layer on the Cr surface in the early stages of oxidation but disappears on further oxidation when the rhombohedral Cr_2O_3 phase predominates. The epitaxial orientation relationships of these oxides and the Cr are explainable in part in terms of the relationships of the crystal structures. The mechanism for the formation of the oxides may be deduced.

7963 **Activity coefficients of lithium dilute in binary alloys: measurements and calculations.** Saboungi, M.L.; Marr, J.; Spineto, S. (Argonne National Lab., IL). *Chemical metallurgy - a tribute to Carl Wagner;* 159-170([nd]).

From 110th AIME Annual Meeting; Chicago, IL, USA (23 Feb 1981).

Electromotive force measurements of the activity of lithium dilute in three binary solvents (Al-Sn, Tl-Bi, and Bi-Pb) have been carried out at constant temperature. The variations of the activity coefficients of Li as a function of the composition of the solvent are analyzed in terms of three different models, the quasi-chemical theory, the Wagner model, and the coordination cluster theory. This last model appears to provide an excellent interpretation of the experimental results.

7964 **Two unusual three-dimensional displays.** Vickers, D.L.; Smith, G.S.; Levine, S.R.; Cross, L.G. Livermore, CA; Lawrence Livermore Lab. ([nd]). 85-101p. Contract W-7405-ENG-48.

Three dimensional computer stored information nearly always is transformed into two dimensions and then plotted on paper, film, or the face of a cathode ray tube. There are, however, several displays on which three-dimensional computer data actually appear three-dimensional and stereoscopic. Two such displays are the integral hologram and the head-mounted display.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 7057, 7495, 7495, 7522, 7630, 7665, 7665, 7712, 7786, 8086

7965 **(BMFT-FB-T—82-138) Development and fabrication of refractory bodies for gas turbine engines.** Hunold, K.; Grellner, W.; Kriegesmann, J.; Lipp, A.; Reinmuth, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82751006.

Two hot pressed silicon carbide materials have been developed. One of them (HP-T) is characterized by a constant strength from room temperature up to high temperatures. Silicon carbide powders for hot pressing can be produced in large quantities. The parameters for hot isostatic pressing (HIP) of silicon carbide powders have been evolved. A new technique for capsulation has been developed. Pressureless sintered (SSiC) and hot pressed (HPSiC) parts were post-densified by hot isostatic pressing. Some properties of the different silicon carbide materials have been evaluated and their potential for the production of gas turbine parts will be discussed.

7966 **(BMFT-FB-T—82-140) Development of high strength silicon carbide materials for gas turbine applications. Phase 2.** Gugel, E.; Leimer, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 43p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82751007.

In the second phase of the project the pressureless sintered, as well as the silicon-containing silicon carbide have been selected from the different silicon carbide materials as most promising for the application in the gas turbine. The main tasks were the material development with the aim of a further improvement of the mechanical properties, the development of shaping as well as the production of prototype components. Pressureless sintered silicon carbide could be further improved. Development projects are presented, microstructure and properties are shown but also the mistakes and further improvements have been pointed out. Here the development of the material was in the foreground, but already first components have been produced. Silicon-containing silicon carbide was already developed to a high level at the time of the project so that the production of complicated prototype components was in the foreground. Nose cones and stators that so far showed good results as stationary gas leading components have been introduced. For the shaping of these parts a special slip casting procedure has been developed.

7967 **(DESY-SR—81/07) Theory of resonant photoemission spectra of 3d transition metal oxides and halides.** Davis, L.C. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1981. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750432.

A simple model is presented to describe resonant photoemission due to super-Coster-Kronig decay of 3p^5 3dsup(N+1) states in transition metal compounds. An explanation is given for the puzzling behavior observed in recent experiments on NiO and $NiCl_2$ in which the multi-electron satellite is enhanced rather than the main valence band. Several experiments are proposed to test the theory.

7968 **(DOE/ER/10588—3) Physics and chemistry of packing fine ceramic powders. Annual report, February 1, 1982-January 31, 1983.** (Massachusetts Inst. of Tech., Cambridge (USA). Materials Processing Center). 22 Oct 1982. Contract AC02-80ER10588. 89p. NTIS, PC A05/MF A01. Order Number DE83002801.

The objective of the proposed research project is to develop a scientific basis for processing ceramic powders. The key problem identified is the lack of control in the packing of submicron powders prior to sintering; thus, the formation, dispersion and packing of particles are the major areas of the study. Theoretical modelling and experimental measurements are being used to understand the

forces and thus enable control of the packing of particles into unfired, densely packed bodies. Three model systems have been chosen - SiO_2, TiO_2 and SiC. We have demonstrated close packed green microstructures for SiO_2 and TiO_2 and in each system surface chemical and powder characteristics have been measured. Uniformly packed TiO_2 was sintered to theoretical density at 800°C. The effects of particle size distribution on slurry stability have been demonstrated with model calculations (e.g., distributions produced by milling are too wide to be stable against agglomeration).

7969 **(GKSS—81/E/33) Influence of grain size on the magnetic interaction in antiferromagnetic α-Cr_2O_3.** Draeger, K.; Gerling, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1981. 5p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750349.

α-Cr_2O_3 powders with grain sizes between 170 and 35 nm have been investigated by EPR between 320 and 520 K and by elastic neutron scattering at 100 and 380 K. The particle sizes were estimated from the line broadening of the diffraction peaks. The application of a statistical model allows us to compute the antiferromagnetic excitation energy ΔE from the EPR intensity. For diameters down to 100 nm, ΔE is given by 430 cm^{-1}. It decreases to 260 cm^{-1} for particles with a size of 75 nm. Correspondingly the magnetic scattering decreases with decreasing particle size. However, the neutron scattering at 100 K still indicates an antiferromagnetic order even for particle sizes of 35 nm whereas there is no hint of residual interaction when considering the EPR intensity.

7970 **(KFK—3087-B) Binary and ternary carbides and nitrides of the transition metals and their phase relations.** Holleck, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Jan 1981. 353p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE82750350.

The occurrance and the structure of the binary and ternary transition metal carbides and nitrides are described. Phase diagrams are assessed for most of the binary and ternary systems. Many ternary phase diagrams are published in this report for the first time.

7971 **(LBL—14797) CaO segregation in MnZn-ferrite.** Lin, I.N.; Mishra, R.K.; Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 13p. (CONF-820727—5). NTIS, PC A02/MF A01. Order Number DE83001551.

From 3. joint intermag-magnetism and magnetic materials conference; Montreal, Canada (17 Jul 1982).

The reaction between CaO and MnZn ferrite is investigated by in-situ heating in a scanning electron microscope. The existence of an intermediate phase and a eutectic liquid at about 1300°C is observed. The CaO segregation behavior of low loss MnZn ferrite is studies by in-situ heating in transmission electron microscope and Auger electron spectroscopy. The Ca is observed to stay at the grain boundaries in the form of amorphous intermediate phase at low temperatures and in a liquid phase at the sintering temperature. 5 figures.

7972 **(MLM—3022(OP)) Vacuum-injection-molding processing.** Kramer, D.P.; Massey, R.T. (Monsanto Research Corp., Miamisburg, OH (USA)). 1982. Contract AC04-76DP00053. 3p. (CONF-821122—5). NTIS, PC A02/MF A01. Order Number DE83001758.

From Conference on glass and ceramic materials; Oak Ridge, TN, USA (8 Nov 1982).

An improved processing technique for the manufacture of glass or glass-ceramic headers has been developed. Vacuum-injection molding is a relatively easy processing technique that has been used successfully in the fabrication of several different advantages in certain applications over the present fabrication process which uses glass preforms.

7973 **(NP—3900247) Influence of the ZrO_2-inclusions on the oxidation behaviour and the resistance to sudden changes of temperature of Si_3N_4-ceramics.** Lupold, R. (Stuttgart Univ. (TH) (Germany, F.R.). Fachbereich Chemie). 14 Jul 1981. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE83900247.

Thesis.

Hot pressed Si_3N_4-ZrO_2 dispersions are stabilized in the cubic state by nitrogen. A destabilization is reached by annealing. This cubic-monoclinic transformation creates compressive stresses in the surface region. An oxidation resistent, monophase material was developped with the help of the SiAlON-system. The mechanical properties served to optimize the material. The influence of the ZrO_2-dispersions to the resistance to sudden changes of temperature was investigated. A method of calculation was developped to examine the residual bending strength measured by quenching the specimens into the water.

7974 **(NP—3900250) Reaction of oxygen with Mo-carbides, W-carbides and WC-Co alloys in the high temperature range.** Kang, S.G. (Stuttgart Univ. (Germany, F.R.)). 4 Jul 1980. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE83900250.

Thesis.

The reaction of oxygen with Mo-carbides and W-carbides as well as with WC-Co-alloys was investigated between 1300 K and 2100 K and in the oxygen partial pressure range from 10sup(-4) up to 40 mbar by a gravimetric method. A metal layer which was formed on the surface reacted with oxygen to evaporating oxides. An equilibrium was adjusted between the formation of the metal layer and the evaporation of the metal oxides. With the help of a created reaction model it was possible to calculate the metal layer thickness in the stationary condition as well as the instationary growth of the scales. Mo-carbides and W-carbides behaved at high temperatures and low oxygen partial pressures like the corresponding metals. The high evaporation of the oxides in combination with the quick CO-reaction led to considerable losses in weight, which exclude largely the application of these high temperature materials in oxygen-containing atmospheres.

7975 **(NP—3900251) Investigations on the crack propagation behaviour of silicon carbide and aluminium oxide in air and in high vacuum at high temperatures.** Popp, G. (Stuttgart Univ. (TH) (Germany, F.R.). Fachbereich Chemie). 9 Apr 1981. 185p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE83900251.

Thesis.

The breaking strength of sintered Al_2O_3, SiC (as reactive compound) and hot-pressed SiC was investigated with compact bending specimens and double torsion specimens in the room and high temperature (up to 1600°C) range and in high vacuum and air. Al_2O_3 shows an intercrystalline and SiC mainly a transcrystalline fracture behavior. In high vacuum at room temperature the Ksub(Ic)-factor is about 15% higher than in air. Over 700°C the Ksub(Ic)-factors assimilate and especially for SiC they are higher in air because of the oxidation in the notch. A strong velocity dependence of the Ksub(Ic)-factor is observed especially between 1100°C and 1400°C for the materials with plasticized grain boundary phases (Al_2O_3, SiC(HP)). For all materials a tendency to subcritical crack propagation is established in high vacuum above 600°C. Similar but amplified tendencies a observed in air. The good applicability of both SiC-ceramic materials in the investigated temperature range is shown by the high n-factors.

7976 **(SAND—82-2335C) Shock-activated sintering.** Graham, R.A.; Beauchamp, E.K.; Morosin, B.; Venturini, E.; Webb, D.M.; Davison, L.W. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 40p. (CONF-820895—1). NTIS, PC A03/MF A01. Order Number DE83001788.

From DARPA dynamic synthesis program review meeting; Albuquerque, NM, USA (5 Aug 1982).

This report describes initial progress on shock-activated sintering of inorganic powders, TiC, TiB_2, AlN and Al_2O_3. After background material is presented, technical activities on controlled shock loading, studies of physical properties of shocked powders and sintering studies are presented. 15 figures.

7977 **Surface diffusion in MgO and Cr-doped MgO.** Lytle, S.A.; Stubican, V.S. (Pennsylvania State Univ, University Park, USA). *Journal of the American Ceramic Society;* **65**: No. 4, 210-212(Apr 1982).

Surfaces diffusion affects processes such as sintering, grain growth, catalysis, and pore migration. An investigation was conducted to determine the effect of chromium dopant on the surface diffusion of MgO. For comparison, surface diffusion was also studied on undoped MgO from two sources. In all cases, surface diffusion was determined using the grain-boundary grooving method. 9 refs.

7978 **Surface areas and morphologies of CaO produced by decomposition of large $CaCO_3$ crystals in vacuum.** Powell, E.K.; Searcy, A.W. (Univ of California, Berkeley, USA). *Journal of the American Ceramic Society;* **65**: No. 3, C.42-C.44(Mar 1982).

The CaO formed by complete isothermal decomposition of calcite single crystals in vacuum has surface areas that range from 127/plus or minus/10 m/sup 2/g at 650/degree/C to 60/plus or minus/20 m/sup 2//g at 900/degree/C. Surface areas are not significantly reduced by annealing at 900/degree/C in vacuum. Scanning electron microscope observations and other available data show that CaO particles, which are first formed in an aggregate with relatively uniform pores, rearrange when the CaO layer thickness exceeds /approximately equals/10 to 50 /mu/m. 15 refs.

7979 **Structural reliability: a processing-dependent phenomenon.** Evans, A.G. (Univ of California, Berkeley, USA). *Journal of the American Ceramic Society;* **65**: No. 3, 127-137(Mar 1982).

The principal sources of fracture in ceramic polycrystals have been identified; they include surface cracks produced during surface finishing and voids, inclusions, or large grains generated during processing. The dominance of a specific fracture source depends on the microstructure, test temperature, and stress distribution. The origins of processing-induced defects have been examined and certain dominant processing variables identified. 42 refs.

7980 **Separation of cavitation-strain and creep-strain during deformation.** Raj, R. (Cornell Univ, Ithaca, NY, USA). *Journal of the American Ceramic Society;* **65**: No. 3, C.46(Mar 1982).

A significant fraction of the strain in high-temperature deformation may arise from cavitation. A methodology is described for separating the creep strain from the cavitation strain. Such a distinction is necessary because cavitation and creep are mechanistically different processes. 3 refs.

7981 **Determination of the parameters of native disorder in α-Al_2O_3.** El-Aiat, M.M.; Kroger, F.A. (Univ of South California, Los Angeles, USA). *Journal of the American Ceramic Society;* **65**: No. 3, 162-166(Mar 1982).

Hydrogen if incorporated in alumina may act as a donor, and as such can be used to compensate acceptor dominated samples. Partial protonic, electronic, and ionic currents can be determined by combining dc conductivity with transference numbers determined by polarization. The values of the conductivities of the native species combined with mobility data can be used to determine the equilibrium constants of native electronic and ionic disorder. 28 refs.

7982 **Effect of pulsed irradiation on void swelling in nickel.** Brimhall, J.L.; Charlot, L.A.; Simonen, E.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1147-1150(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

This study has compared the void microstructure in nickel induced by a pulsed ion bombardment to that induced by a steady-state irradiation. Pulse cycles of 10 seconds on and 10 seconds off produced no measurable difference in the void growth and swelling in the temperature range 775 to 975 K compared to continuous irradiation at the same instantaneous dose rate. Void annealing during the pulse annealing period was minimal due to the large void sizes which were obtained in these irradiations. Hence no measurable effect of pulsing on void growth was observed.

7983 **Displacement cascades in diatomic materials.** Parkin, D.M. (Los Alamos National Lab., NM (USA)); Coulter, C.A. (Alabama Univ., University (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1315-1318(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

A new function, the specified-projectile displacement function psub(iik) (E), is introduced to describe displacement cascades in polyatomic materials. This function describes the specific collision events that produced displacements and hence adds new information not previously available. Calculations of psub(iik) (E) for MgO, Al_2O_3 and TaO are presented and discussed. Results show that the parameters that have the largest effect on displacement collision events are the PKA energy and the mass ratio of the atom types in the material. It is further shown that the microscopic nature of the displacement events changes over the entire recoil energy range relevant to fusion neutron spectra and that these changes are different in materials whose mass ratio is near one than in those where it is far from one.

7984 **Computer simulation of high energy recoils in FCC metals: Cascade shapes and sizes.** Heinisch, H.L. (Hanford Engineering Development Lab., Richland, WA (USA)). *Journal of Nuclear Materials;* **104**: No. 1-3, 1325-1330(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Displacement cascades in copper generated by primary knock-on atoms with energies from 1 keV to 500 keV were produced with the computer code MARLOWE. The sizes and other features of the point defect distributions were measured as a function of energy. In the energy range from 30 keV to 50 keV there is a transition from compact single damage regions to chains of generally closely-spaced, but distinct multiple damage regions. The average spacing between multiple damage regions remains constant with energy. Only a small fraction of the recoils from fusion neutrons is expected to produce widely separated subcascades.

7985 **Influence of microcracking and slow crack growth on the planar coupling coefficient in PZT.** Chiang, S.S.; Fulrath, R.M.; Pask, J.A. (Univ of California, Berkeley, USA). *Journal of the American Ceramic Society;* **64**: No. 10, C.141-C.143(Oct 1981).

The difference in the planar coupling coefficient, k/sub p/, of two PZT specimens with different grain sizes under the same poling treatment was attributed to a greater tendency for microcracking in the large grain-size specimens. In the absence of microcracking, as shown in small grain-size specimens, the decrease in k/sub p/ and failure of the poled specimens is attributed to slow crack growth. The optimum poling conditions for small grain-size specimens were evaluated in terms of reducing the slow crack-growth effect. 19 refs.

7986 **Thermal segregation of cations in iron aluminate spinels.** Petuskey, W.T.; Bowen, H.K. (Univ of Illinois at Urbana-Champaign, USA). *Journal of the American Ceramic Society;* **64**: No. 10, 611-617(Oct 1981).

An examination was conducted on the effects of a temperature gradient on the distribution of iron and aluminum cations in iron aluminate spinels for the cases where the cation vacancies have been completely restricted or allowed to flow freely. A comparison of both cases yields insight into the mechanisms through which segregational forces act and their relative magnitudes of importance. This paper examines the conditions under which cation segregation can be expected in oxide solid solutions where the oxygen sublattice is essentially rigid relative to the mobile cations. 20 refs.

7987 **Galvanic cell measurements with stabilized zirconia and platinum probes.** Dudney, N.J.; Coble, R.L.; Tuller, H.L. (MIT, Cambridge, MA, USA). *Journal of the American Ceramic Society;* **64**: No. 10, 621-624(Oct 1981).

A galvanic cell technique was developed to measure the ionic and electronic transference numbers of metal oxides at high temperatures. The cell uses stabilized zirconia probes in addition to the conventional metal probes. With both types of probes, meas-

urements of the transference numbers for electronic, ionic, or mixed conductors are possible and surface polarization effects are readily detected. 6 refs.

7988 **Thermal diffusivities of molybdenum/alumina cermets.** Miller, H.C. (GE, St. Petersburg, FL, USA). *Journal of the American Ceramic Society;* **64**: No. 10, C.136-C.138(Oct 1981).

The thermal diffusivities of several molybdenum/alumina cermets were measured using a transient heat-flow, semi-infinite plate method. The cermets had thermal diffusivities significantly greater than those of 94% Al/sub 2/O/sub 3/ alumina. A 50/50 wt% cermet had a thermal diffusivity of 0.102 cm/sup 2//s at 313 K, while the alumina had a value of 0.067 cm/sup 2//s. 7 refs.

7989 **Electrical conductivity of $MgAl_2O_4$ and $Y_3Al_5O_{12}$.** Bates, J.L.; Garnier, J.E. (Battelle, Pac Northwest Lab, Richland, WA, USA). *Journal of the American Ceramic Society;* **64**: No. 10, C.138-C.140(Oct 1981).

The electrical conductivities of single crystal and polycrystalline MgAl/sub 2/O/sub 4/ and Y/sub 3/Al/sub 5/O/sub 12/ were measured to 1260 K using a three-contact, guard-ring technique. The electrical conduction mechanisms change with temperature with anomalous oxygen pressure and time-dependent inflections in log /sigma/ versus T/sup -1/ curves between 900 to 1000 K. The conduction processes of Y/sub 3/Al/sub 5/O/sub 12/ and MgAl/sub 2/O/sub 4/ appear to be similar and possibly related to Al/sup 3+/ ion diffusion. 7 refs.

7990 **Activation energies for densification, creep, and grain-boundary sliding in nitrogen ceramics.** Raj, R.; Morgan, P.E.D. (Cornell Univ, Ithaca, NY, USA). *Journal of the American Ceramic Society;* **64**: No. 10, C.143-C.145(Oct 1981).

The activation energies for densification, creep, and grain-boundary sliding in HP-Si/sub 3/N/sub 4/ are consistent and large, approaching the heat of sublimation of Si/sub 3/N/sub 4/. If solution-precipitation through the intergranular glass (or fluid) is invoked as a common underlying mechanism, then it can be concluded that the high activation energy results from the high heat of solution of the crystal into the glass. This is consistent with the finding that it is difficult to retain Si/sub 3/N/sub 4/ in a glassy state. 14 refs.

7991 **Modifications in optoelectronic behavior of plasma-deposited amorphous semiconductor alloys via impurity incorporation.** Griffith, R.W.; Kampas, F.J.; Vanier, P.E.; Hirsch, M.D. (Brookhaven National Lab., Upton, NY). *Journal of Non-Crystalline Solids;* No. 35-36, 391-396(1980).

Electronic properties of plasma-deposited a-Si:H alloys are discussed as functions of oxygen and nitrogen impurities. Over a wide range of processing conditions, features displayed by the data include: (1) anomalous behavior in photoconductivity versus temperature for films deficient in either, or both, impurities (peaks appear that are associated with thermal-quenching processes and supralinearity); and (2) modification to classic behavior in photoconductivity owing to synergistic effects of oxygen and nitrogen. Correlations with photoluminescence are presented. Optical emission spectroscopy is discussed within the context of an emerging spectroscopy for the detection of emitting reactive species in the plasma. The presence of impurities, particularly N_2, can be diagnosed.

7992 **Domain and surface structures of sodium tungsten bronzes, Na/sub x/WO_3 ($0.4 < x < 1$).** Atoji, M. (Argonne National Lab., IL). *Journal of Solid State Chemistry;* **31**: 113-125(1980).

Polarized-light microscopic observations have shown that the birefringent, twin-domain structure of metallic sodium tungsten bronze is exhibited by Na-deficient surface films and hence is not, as had been reported elsewhere, a bulk property. The film can be synthesized by anodic electrolysis in alkaline solution. It is chemically inert, translucent, and often laminates to a multiple layer. The domain structure of the film is hypersensitive to lateral stress and to thermal variation, exhibiting a marked change at the phase transition of the substrate through apparent epitaxial coherence. The domain-wall movement is often slow enough to be visible, and the thermally induced domain modulation is occasionally accompanied by audible high-pitched sound. The bulk structure of the substrate exhibits pseudoperiodic subboundaries that are probably caused by growth defects and the segregation of the sodium atoms. The near-surface of the substrate also shows the sodium segregation that tends to precipitate in periodic patterns. Optical and morphological properties of the substrate structures exhibited no detectable change due to thermal variation or external stress.

3603 Composite Materials

REFER ALSO TO CITATION(S) 6994, 7241, 7242, 7243, 7244, 7674, 7898

7993 **(RFP—3349) Low-density carbon: carbon composites.** Brassell, G.W. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1981. Contract AC04-76DP03533. 11p. (CONF-820398—1). NTIS, PC A02/MF A01. Order Number DE83000692.

From Rockwell International seminar; Tulsa, OK, USA (24 Mar 1982).

A low-density, discontinuous carbon fiber composite material has been developed primarily for use in advanced aerospace systems. The material is ideally suited for high-temperature applications (to 2500°C) which require excellent thermal insulation and load support. The composite consists of short carbon fibers (10 to 30 mils long) bonded together with a small amount of pyrolyzed phenolic (carbon) binder. A vacuum filtration process, utilizing a dilute water slurry containing carbon fibers and phenolic particles, is used in fabricating the composite material. Flat slabs, hollow cylinders, and hollow conical frusta are some of the more conventional shapes which have been formed with this process. Curing, drying, and pyrolizing operations are employed to effect a semirigid, carbon-bonded fibrous structure. Bulk densities between 0.11 and 0.26 gm/cc were obtained by adjusting the material parameter and processing techniques. Compressive strengths generally increased with density and were in the range from (15 to 170 psi) at a 10% deflection. Typical values of thermal conductivity, in an argon atmosphere, were between 0.1 and 0.2 W/m/°C at a 1000°C mean temperature.

7994 **(SAND—82-2255C) Analysis of center-notched, unidirectional composites.** Reedy, E.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 18p. (CONF-821132—1). NTIS, PC A02/MF A01. Order Number DE83002509.

From Workshop on mechanics of fracture and damage; Stone Mountain, GA, USA (22 Nov 1982).

A method for calculating the stresses in a notched, unidirectional monolayer is described which permits the modeling of a finite-dimensioned monolayer containing a centered notch transverse to the fibers. Elastic-work hardening constitutive relationships may be specified for the fibers and/or matrix. Notch growth under increasing load can be analyzed. Calculations demonstrate the utility of this analysis in determining how constituent properties affect notch-tip fiber stress concentrations. Calculations for unidirectional boron/aluminum indicate that stress concentrations are reduced by a matrix with: (1) sufficiently high yield strength to prevent large-scale yielding (uniform traction loading can cause large fiber stress concentrations when global yielding occurs); and (2) a low rate of work-hardening (to reduce stress concentrations). The analysis has also been applied to Kevlar 49 plain weave fabric/epoxy monolayers. Predicted matrix and fiber stress concentrations are localized in this material with nonlinear material response limited to the notch-tip region. This is different from the widespread yielding in as-fabricated, unidirectional boron/aluminum. 6 figures.

7995 **Influence of mixing medium on sintering and coupling coefficient of PZT ceramics.** Nishioka, M. (Lawrence Berkeley Lab., CA); Chiang, S.S.; Fulrath, R.M.; Pask, J.A. *Ceramics International;* **7**: No. 3, 87-89(1981). Contract W-7405-ENG-48.

Microstructure and properties of lead zirconate-titanate (PZT) are sensitive to the various steps in the fabrication process. This study investigated the influence of the mixing medium, dis-

tilled water or isopropyl alcohol, used with polyvinyl alcohol (PVA) binder on the sintering behavior and coupling coefficient (K/sub p/) of a Pb (Zr/sub 0.5/Ti/sub 0.5/) 0_3 composition.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 7655, 8066, 8169, 8272, 8273

7996 (JINR—18-81-657) Measurements of diameters of selectively etchable tracks produced in polymer by heavy ions. Apel', P.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1981. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702910.

Submitted to the journal Nucl. Tracks.

The process of pore formation in polyethyleneterephtalate films irradiated by the ^{136}Xe, ^{84}Kr, ^{40}Ar ions was investigated by measuring the conductivity of the samples during etching. The diameters of the damaged tracks within which the local etching rate was larger than etching rate for non-destroyed polymer were determined. In the case of the ^{136}Xe ions measurements have been carried out at different ion energies.

7997 Method for making block siloxane copolymers. Butler, N.; Jessop, E.S.; Kolb, J.R. (to Department Of Energy). US Patent 4,348,504. 7 Sep 1982. Filed date 25 Feb 1981. vp.

PAT-APPL-238235.

A method for synthesizing block polysiloxane copolymers is presented. Diorganoscyclosiloxanes and an end-blocking compound are interacted in the presence of a ring opening polymerization catalyst, producing a blocked prepolymer. The prepolymer is then interacted with a silanediol, resulting in condensation polymerization of the prepolymers. A second end-blocking compound is subsequently introduced to end-cap the polymers and copolymers formed from the condensation polymerization.

3606 Other Materials

REFER ALSO TO CITATION(S) 6781, 6782, 6783, 6783, 6787, 6788, 6789, 6789, 6791, 6794, 6796, 6797, 6798, 6799, 6806, 7007, 7042, 7043, 7044, 7046, 7050, 7051, 7053, 7117, 7121, 7485, 7485, 7522, 7529, 7529, 7530, 7530, 7968, 8070, 8070, 8077, 8150, 8203, 8204, 8504

7998 (AD-A—114869/1) Thermodynamics of high temperature materials. Annual report 1 Oct 81-1 Apr 82. Abramowitz, S.; Cezairliyan, A.; Mies, F.; Julienne, P. (National Bureau of Standards, Washington, DC (USA)). Sep 1981. 107p. NTIS, PC A06/MF A01.

Heat capacity and electrical resistivity of graphite have been measured in the range of 2500 to 3600 K. Thermal expansion of tantalum has been measured in the range of 1500 to 3200 K. Radiance temperature (at 653 nm) of tungsten at its melting point has been determined. The enthalpy of graphite has been determined from 273 to 1173 K. The thermodynamic properties of diatomic molecules at elevated temperatures have been investigated and a formalism developed to include contributions from both the continuum states and the metastable states associated with rotational barriers. The determination of barriers to internal rotation for inorganic species has been reviewed.

7999 (BNL—31919) Spin correlations near the ferromagnetic-spin glass crossover in Eu/sub x/Sr/sub 1-x/S. Maletta, H.; Aeppli, G.; Shapiro, S.M. (Brookhaven National Lab., Upton, NY (USA)). Sep 1982. Contract AC02-76CH00016. 25p. (CONF-820929—9). NTIS, PC A02/MF A01. Order Number DE83000818.

From IUPAP international conference on magnetism; Kyoto, Japan (6 Sep 1982).

Portions of document are illegible.

Bulk susceptibility and high-resolution neutron-diffraction measurements have been performed on single crystals of Eu/sub x/Sr/sub 1-x/S for x = 0.52 and 0.54 near the ferromagnet (FM) - spin glass (SG) crossover. A reentrant phase is established, which is induced by random-field effects. As the temperature is reduced the FM correlation length ξ passes through a resolution-limited maximum where a frustrated FM phase is observed. In the SG at lower temperature ξ decreases again and a coexisting FM component can be excluded. 6 figures.

8000 (BNL—31939) Application of XANES to the study of AsF_5-graphite intercalation compounds. Heald, S.M.; Goldberg, H.A.; Kalnin, I.L. (Brookhaven National Lab., Upton, NY (USA); Celanese Research Co., Summit, NJ (USA)). 1982. Contract AC02-76CH00016. 3p. (CONF-820957—3). NTIS, PC A02/MF A01. Order Number DE83002217.

From International conference EXAFS and near edge structures; Frascati, Italy (13 Sep 1982).

X-ray absorption spectra were used to study the structure of two samples: HOPG and Celion Gy-70 fibers. Data were obtained perpendicular and parallel to the fiber axis. For the fiber, the reaction goes to completion. The AsF_3 peak is orientation-dependent. (DLC)

8001 (DOE/ER/10887—2) Experimental study of the thermodynamics of thin films and surfaces. Progress report for 1982. Dahlberg, E.D.; Goldman, A.M. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Nov 1982. Contract AC02-81ER10887. 18p. NTIS, PC A02/MF A01. Order Number DE83003379.

Semiconductor membrane calorimeters are in the process of development. They will be used to investigate thermodynamic properties of thin films and surfaces using ac calorimetry. The membranes are being formed using directional and selective etching techniques on semiconductor wafers. The procedures being developed to form calorimeters and to affix heaters, thermometers and electrical leads are a generalization of those used to fabricate Si membrane Josephson junctions.

8002 (IKF—41, pp 76) Experiments on electron beam annealing at the 2.5 MV accelerator. Langfeld, R.; Baumann, H.; Bethge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8003 (IKF—41, pp 78-79) Electron beam annealing of arsenic deep implantations in silicon. Wondrak, W.; Baumann, H.; Bethge, K.; Krimmel, E.F. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8004 (JAERI-M—9758) Compressive stress-strain relationships for nuclear graphites. Yoda, Shinichi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1981. 37p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702907.

Compressine stress-strain relationships for nine commercial graphite materials produced by four various methods, extrusion, molding, vibration molding, and isostatic press, were systematically studied, Polynomial expressions for stress-strain curves of the graphites were proposed all over strains to the fractures. The effects of anisotropy induced by alignment of grains on stress-strain curves and the effects of applied stress on plastic strains were also examined. The flow stress of the with-grain specimen were larger than that of across-grain specimen at small strain (<1%). The effects of compressive stress on Young's modulus were examined using ultrasonic wave velocity. The Young's modulus of the graphites decreased successively with increasing applied stress. The origin of the phenomenon was attributable to the change in pore configuration under compressive stress.

8005 (SAND—82-1338C) Measurements of ion-implantation damage in GaP. Myers, D.R.; Peercy, P.S.; Gourley, P.L. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 5p. (CONF-821107—18). NTIS, PC A02/MF A01. Order Number DE83002140.

From 6. international symposium on the scientific basis for radioactive waste management; Boston, MA, USA (1 Nov 1982).

We have applied stress measurements using the cantilever beam technique and Raman spectroscopy to characterize the dose dependence of damage production for He^+, C^+, or Ar^+ implants into GaP. Stress increases monotonically with dose until a species-dependent critical dose is reached. Above that dose, the material yields at an integrated lateral stress of $\sim 2 \times 10^5$ dynes/cm, corresponding to an expansion of $\sim$ 1% in the implanted volume. The dose dependence of stress scales well with the volume density of ion energy deposited into atomic collisions. Raman measurements indicate that the material is still crystalline when the yield stress is reached.

8006 **(SAND—82-1587C) Atomic interdiffusion in Au/amorphous NiNb/semiconductor systems.** Doyle, B.L.; Peercy, P.S.; Thomas, R.E.; Perepezko, J.H.; Wiley, J.D. (Sandia National Labs., Albuquerque, NM (USA); Wisconsin Univ., Madison (USA)). 1982. Contract AC04-76DP00789. 23p. (CONF-821107—20). NTIS, PC A02/MF A01. Order Number DE83002553.

From 6. international symposium on the scientific basis for radioactive waste management; Boston, MA, USA (1 Nov 1982).

Portions of document are illegible.

Backscattering measurements were performed to assess the stability of amorphous NiNb for contacts of high temperature electronics. The interdiffusion of amorphous NiNb and three semiconductors - Si, GaAs and GaP - was measured to study the stability for primary metallization applications. Diffusion of Au with amorphous NiNb and the same three semiconductors were also investigated in order to address diffusion barrier applications of amorphous metals. Results indicate that the use of amorphous NiNb as a contact or a diffusion barrier could extend the useful operation temperature range for GaP devices to above 550°C. 6 figures.

8007 **(STUDSVIK-NW—81/171) Some supplementary ultrasonic measurements on concrete and bitumen containing ionic exchange resin.** Robinson, T.; Sjoeblom, R. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 15 Dec 1981. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702908.

Data obtained previously on the velocity and absorption of ultrasonic waves in concrete and bitumen containing different amounts of ion exchange resin have been supplemented by measurements at a lower temperature (-35°C) and on samples which had been immersed in water for several days.

8008 **Method of forming single crystals of beta silicon carbide using liquid lithium as a solvent.** Lundberg, L.B. (to Department Of Energy). US Patent 4,349,407. 14 Sep 1982. Filed date 9 May 1979. vp.

PAT-APPL-037247.

A method of growing single crystals of beta SiC from solution using molten lithium as a solvent for polycrystalline SiC feed material is described. Reasonable growth rates are accomplished at temperatures in the range of about 1330 to about 1500°C.

8009 **Open-tube method for diffusion of zinc into GaAs.** Field, R.J.; Ghandhi, S.K. (Rensselaer Polytech Inst, Troy, NY, USA). *Journal of the Electrochemical Society;* **129**: No. 7, 1567-1570(Jul 1982).

Highly reproducible zinc diffusions from 0.03 to 1.5 /mu/m have been made into GaAs using a CVD zinc-doped silica source capped with phosphosilicate glass. This structure permitted the use of an open-tube, flowing inert gas diffusion system. Diffusions were made from 400/degree/ to 700/degree/C, with surface hole concentrations from 0.1 to 1.0*10/sup 20/ cm/sup -3/, and junction depths from 300A to 1.5 /mu/m. The diffusion coefficient and the hole concentration obtained by this technique are very close to those obtained by sealed ampul techniques using a Zn/sub 3/A/sub 2/ source. However, this open-tube system is more convenient to use, and gives highly reproducible results. 13 refs.

8010 **Reaction of oxygen with Si(iii) and (100): critical conditions for the growth of SiO_2.** Smith, F.W.; Ghidini, G. (City Univ of New York, NY, USA). *Journal of the Electrochemical Society;* **129**: No. 6, 1300-1306(Jun 1982).

The reactions of oxygen (O/sub 2/) with the clean Si(111) and (100) surfaces have been studied at high temperatures (890/degree/-1150/degree/C) for oxygen pressures between 5*10/sup -5/ and 5*10/sup -2/ Torr. The critical conditions involving oxygen pressure and substrate temperature which are necessary for the growth of SiO/sub 2/ to occur on these Si surfaces have been determined, and are found to be independent of substrate orientation and doping type under the conditions studied. The observed critical conditions for growth are consistent with a theoretical model which focuses on the kinetics of SiO/sub 2/ cluster growth and on the thermodynamics of the competing etching reaction leading to production of SiO. Evidence is presetnted for epitaxial growth on Si(100) of cubic SiO/sub 2/, /beta/-cristobalite. 16 refs.

8011 **Calculation of carrier concentration in polycrystalline films as a function of surface acceptor state density: application for ZnO gas sensors.** Leary, D.J.; Barnes, J.O.; Jordan, A.G. (Carnegie-Mellon Univ, Pittsburgh, PA, USA). *Journal of the Electrochemical Society;* **129**: No. 6, 1382-1386(Jun 1982).

An analysis employing Poisson's equation is used to determine surface potential and effective carrier concentration as a function of N/sub ss/, the surface acceptor concentration, for a particular set of material parameters in RF- sputtered ZnO thin films. The results are used to obtain a semiquantitative description of gas sensitivity addressing electronic processes of the gas-solid system. The analysis involves numerical solution of Poisson's equation and the charge neutrality equation simultaneously. 8 refs.

8012 **Mechanism of electrodeposition of silicon from K_2SiF_6-LiF/NaF/KF.** Elwel, D.; Rao, G.M. (Stanford Univ, CA, USA). *Electrochimica Acta;* **27**: No. 6, 673-676(Jun 1982).

Cyclic voltammetry data for stationary and rotating electrodes are presented for electrodeposition of silicon from solutions of K/sub 2/SiF/sub 6/ in the LiF/NaF/KF eutectic. It is concluded that electron transfer is the main rate controlling mechanism but that solute diffusion cannot be neglected. The interface process is preceeded by a chemical reaction, probably dissociation of polynuclear Si/sub n/F/sub 2n+2/ complexes.

8013 **Reactive ion etching of silicon dioxide.** Light, R.W.; See, F.C. (Sandia Natl Lab, Albuquerque, NM, USA). *Journal of the Electrochemical Society;* **129**: No. 5, 1152-1154(May 1982).

The problem is explored of selectively etching SiO/sub 2/ over a silicon substrate by using a planar, dual plasma/reactive ion etching system with a 3000 W, 13.56 MHz rf power supply. Selective etching is achieved with CHF/sub 3/ at applied powers between 2500 and 3000 W by adjusting the chemistry of the plasma with the P/F ratio toward the onset of polymerization and then optimized by the pressure within the limits of the pumping speed of the system. 3 refs.

8014 **Mixed-alkali effect in low-alkali germanate glasses.** Cordaro, J.F.; Tomozawa, M. (Rensselaer Polytech Inst, Troy, NY, USA). *Journal of the American Ceramic Society;* **65**: No. 4, C.50-C.51(Apr 1982).

Direct-current conductivities of mixed-alkali Na/sub 2/O-K/sub 2/O-GeO/sub 2/ glasses with about 0.02 mol% total alkali were investigated. No minima in conductivity isotherms were indicated as K/sub 2/O is substituted for Na/sub 2/O. However, a conductivity-suppressing effect with the addition of K/sub 2/O to Na/sub 2/O-GeO/sub 2/ glass was demonstrated, from the comparison with the conductivity of Na/sub 2/O-GeO/sub 2/ glasses of varied sodium content (0.0079 approximately 0.30 mol% Na/sub 2/O). 10 refs.

8015 **Quantitative determination of the hydroxyl content of vitreous silica.** Shelby, J.E.; Vitko, J. Jr.; Benner, R.E. (Sandia Natl Lab, Livermore, CA, USA). *Journal of the American Ceramic Society;* **65**: No. 4, C.57-C.60(Apr 1982).

The molar extinction coefficient for bound water in the form of hydroxyl in vitreous silica has been determined by a thermogravimetric technique. The value obtained, 181 L/mol*cm, is believed to be considerably more accurate than the values now used. 9 refs.

8016 **Effect of water content on the chemical durability of Na_2O-$3SiO_2$ glass.** Tomozawa, M.; Erwin, C.Y.; Takata, M.; Watson, E.B. (Rensselaer Polytech Inst, Troy, NY, USA). *Journal of the American Ceramic Society;* **65**: No. 4, vp(Apr 1982).

Na_2O-$3SiO_2$ glasses with high water content were prepared under high-pressure, hydrothermal conditions and their chemical durabilities in water were measured at atmospheric pressure and 30/degree/C. Chemicaldurability decreases with increasing water content. 20 refs.

8017 **Formation of oxynitride glasses by ammonolysis of gels.** Brinker, C.J. (Sandia Natl Lab, Albuquerque, NM, USA). *Journal of the American Ceramic Society;* **65**: No. 1, C.4-C.5(Jan 1982).

Porous borosilicate gels were heated in ammonia at 460/ degree/C. The ammonia treatments reduced the carbon and hydrogen content and increased the gel sintering temperature. The increased sintering temperature was attributed to an increase in T/sub g/ due to chemically dissolved nitrogen. 15 refs.

8018 **Experiences with a model for irradiation induced changes in graphite material.** Cords, H.; Kleist, G.; Zimmermann, R. Juelich, Germany; Kernforschungsanlage (1982). 989p. (In German). (Juel-Spez—149).

In the present report a method is introduced by which it has become possible to analyze data for irradiation induced changes in graphite utilizing mahematical-physical aids. The analysis was performed with more than thirty graphite grades for four property changes and both directions of anisotropy. As a result, smooth data sets completed by means of interpolation and extrapolation methods are presented in both graphical and mathematical-functional ways. The graphite data cover irradiation temperatures ranging between 300°C and 1400°C and irradiation doses up to approximately the limits of service life. Statistical errors due to experimental uncertainties are also determined as a function of dose and temperature. The semi-empirical damage model employed for the analysis is derived from physical principles. It is explained in detail and its limits and potential for further use are discussed. The understanding of radiation damage in graphite has been augmented. The theoretical basis for the model is provided by the well-known concept of equivalent temperatures and a comparison is made with the theory of B. T. Kelly.

8019 **Photoelectron-spectroscopic determination of lattice self-potentials in lanthanide trifluorides.** Thorn, R.J. (Argonne Natl Lab, IL, USA). *Journal of Physics and Chemistry of Solids;* **43**: No. 4, 393-403(1982).

Since the photoelectron spectroscopically measured binding energies probe the potentials at the cation and anion sites separately in solids, there should be a direct determination of the lattice self-potentials at these sites through comparisons with the respective ionization potentials of the gaseous ions. In a study of the photoionization of the 1s orbital electrons on the fluoride ion and of the outer 5p or 4f orbital electrons on the cations of the lanthanide trifluorides, it is found that the so determined lattice self-potentials at the anion sites deviate from those calculated from the electrostatic interactions in the point charge model by an amount which can be explained in terms of ionicity. For the cations, however, the deviations for all except La/sup 3+/ and perhaps Gd/sup 3+/ exceed those expected for ionicity in the point charge model by as much as 2.3 ev in the case of the maximum at Pr/sup 3+/. 31 refs.

8020 **Preparation of device quality gallium phosphide by metal organic chemical vapor deposition.** Biefeld, R.M. (Sandia National Labs., Albuquerque, NM). *Journal of Crystal Growth;* **56**: 382-388(1982). Contract AC04-76DP00789.

Device quality epitaxial layers of gallium phosphide were grown on gallium phosphide substrates by the decomposition of trimethylgallium (TMG) and phosphine in a hydrogen atmosphere. The lowest background carrier concentration ($\sim 5 \times 10^{15}$ cm^{-3}) and best surface morphology were obtained at a growth temperature of 800°C and a PH_3/TMG ratio $\sim$ 10 for a growth rate of 0.17 μm/min. The layers can be controllably doped n- or p-type by the use of hydrogen selenide or diethylzinc. Both n- and p-type material with mobilities of $\sim$ 120 cm^2/V.s and carrier concentrations of $\sim 10^{16}$ cm^{-3} can be prepared. Rectifying diodes with reverse leakage currents of <10 μA at 120 V were grown.

8021 **Self-diffusion of ^{45}Ca and ^{88}Y in pure and YF_3-doped CaF_2 single crystals.** Kucheria, C.S.; Berard, M.F. (Iowa State Univ, Ames, USA). *Journal of the American Ceramic Society;* **64**: No. 10, 594-600(Oct 1981).

Tracer self-diffusion coefficients for Ca and Y were measured in pure and YF/sub 3/-doped CaF/sub 2/ crystals for dopant levels ranging from 2 to 10 mol % and temperatures between 960/ degree/ and 1212/degree/C. Coefficients for both cations increased approximately linearly with the square of the dopant concentration at constant temperature. The activation energies for diffusion of both cations decreased with increasing dopant concentration. Atomic jump pathways are considered, and the decrease in activation energy is explained in terms of reduction in the enthalpy of motion accompanying the formation of Willis anion defect clusters in the more heavily doped crystals. 28 refs.

8022 **Transient capacitance studies of a low-lying electron trap in n-type silicon.** Jellison, G.E. Jr.; Cleland, J.W.; Young, R.T. (Oak Ridge National Lab., TN). pp 241-246 of Defects in semiconductors. Narayan; Tan (eds.). Amsterdam, Netherlands; North-Holland, Inc. (1981). Contract W-7405-ENG-26.

A new electron trap has been observed in electron-irradiated n-type silicon at E/sub c/ - E/sub T/ = 0.105 eV using transient capacitance techniques. It is found that the maximum transient capacitance response is observed only when the majority carrier pulse width is much smaller than some characteristic time constant, and when the time between pulses is much larger than another characteristic time constant. It is shown that this defect is related to an electron trap at E/sub c/ - E/sub T/ = 0.172 eV (probably the oxygen-vacancy or A-center); it is believed that this trap is induced by the electric field found in the depletion region of a p-n junction.

8023 **LEED investigation of (111) oriented Si, Ge, and GaAs surfaces following pulsed laser irradiation.** Zehner, D.M.; Noonan, J.R.; Davis, H.L.; White, C.W.; Ownby, G.W. (Oak Ridge National Lab., TN). pp 111-116 of Laser and electron-beam solid interactions and materials processing. Gibbons; Hess; Sigmon (eds.). Amsterdam, Netherlands; Elsevier North Holland, Inc. (1981). Contract W-7405-ENG-26.

The low energy electron diffraction (LEED) patterns obtained from clean (111) oriented Si, Ge, and GaAs single crystals subsequent to their irradiation with the output of a pulsed ruby laser in an ultra-high vacuum (uhv) environment suggest that metastable (1 x 1) surface structures are produced in the regrowth process. Conventional LEED analyses of the Si and Ge surfaces suggest that they terminate in registry with the bulk but that the two outermost interlayer spacings differ from those of the bulk. For the case of Si these changes are a contraction of 25.5 +- 2.5% and an expansion of 3.2 +- 1.5% between the first and second and second and third layers, respectively.

8024 **Analysis of defects in laser-annealed GaAs.** Fletcher, J.; Narayan, J.; Lowndes, D.H. (Oak Ridge National Lab., TN). pp 421-430 of Defects in semiconductors. Narayan; Tan (eds.). Amsterdam, Netherlands; North-Holland, Inc. (1981). Contract W-7405-ENG-26.

The nature and depth distributions of residual damage in ion implanted and pulsed ruby laser annealed GaAs have been studied using both plan-view and cross-section transmission electron microscopy (TEM) specimens for high dose (1.0×10^{15} cm^{-2}) Zn^+, Se^+, and Mg^+ implants. It was found that laser energy densities above 0.36 J/cm^2 were required to remove the implantation damage, this threshold energy density giving good agreement with that indicated by electrical activation measurements. Laser induced surface degradation of the GaAs was present even for energy densities as low as 0.25 J/cm^2, and more severe damage, with the introduction of dislocations near the surface, was present for energy densities above 0.8 J/cm^2. The use of thin SiO_2 layers for encapsulation during laser annealing was found to substantially reduce this surface degradation.

8025 **Pulsed-laser annealing of ion-implanted GaAs: theory and experiment.** Wood, R.F.; Lowndes, D.H.; Christie, W.H. (Oak Ridge National Lab., TN). pp 231-238 of Laser and electron-beam solid interactions and materials processing. Gibbons; Hess; Sigmon (eds.). Amsterdam, Netherlands; Elsevier North Holland, Inc. (1981). Contract W-7405-ENG-26.

It is shown that, in the pulsed-laser irradiation of crystalline or lightly damaged GaAs, good agreement is obtained between measured and calculated thresholds for melting, for catastrophic damage due to vaporization, and for the duration of surface melting at various energy densities. Good agreement between theory and experiment is also obtained for dopant profile spreading during pulsed-laser annealing.

8026 **Pulsed ruby laser annealing of Zn, Mg, Se, and Si ion implants in semiconducting GaAs.** Lowndes, D.H.; Cleland, J.W.; Christie, W.H.; Eby, R.E. (Oak Ridge National Lab., TN). pp 223-230 of Laser and electron-beam solid interactions and materials processing. Gibbons; Hess; Sigmon (eds.). Amsterdam, Netherlands; Elsevier North Holland, Inc. (1981). Contract W-7405-ENG-26.

The properties of p+ and n+ layers formed by pulsed ruby laser annealing (PRLA) of shallow (R/sub p/ ~ 320 to 680 A) implantations of Mg, Zn, Si, and Se ions in both n- and p-type semiconducting GaAs have been evaluated using a combination of SIMS and electrical properties measurements. High activation (>80%) was obtained for high dose (5×10^{15} ions/cm^2) implants of both Mg and Zn, within a pulsed laser energy density window 0.5 $\leqq$ E/sub l/ $\leqq$ 0.8 J/cm^2 (FWHM pulse duration = 20 to 25 ns). SIMS measurements following PRLA show a well-behaved increasing penetration of dopant ions into the GaAs substrate, with dopant ion concentrations well in excess of 10^{20} ions/cm^3 in the near-surface region. Measured hole mobilities are consistent with the values anticipated for these high concentrations of ionized impurity scattering centers.

8027 **Constructed segments on faulted dipoles in germanium.** Chiang, S.W.; Carter, C.B.; Kohlstedt, D.L. (Cornell Univ., Ithaca, NY). *Scripta Metallurgica;* **14**: No. 7, 803-807(1980).

Weak-beam transmission electron microscopy studies in Si and Ge have indicated dislocations which have recently been proposed to be dissociated when they lie on the glide plane but constricted when they lie on the shuffle plane. Reported observations of constricted segments rather than the isolated cusps or constrictions along faulted dipoles in Ge are recorded herein. Models of possible configurations for a faulted dipole with a constricted segment are presented, and at least three different mechanisms are proposed for the formation of the constricted length of the faulted dipole. (BLM)

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 6712, 6970, 6983, 6987, 7064, 7067, 7911, 8019, 8087, 8101, 8226, 8236, 8238, 8239, 8359, 8476, 8477, 8602

8028 **(AD-A—114575/4) An improved light hydrocarbon analysis system. Interim report.** Lamontagne, R.A. (Naval Research Lab., Washington, DC (USA)). 11 May 1982. 10p. NTIS, PC A02/MF A01.

A system for extracting and measuring ambient levels of C1-C4 hydrocarbons and carbon monoxide (CO) in seawater is described. The analytical instrument is a gas chromatograph with flame ionization detectors that incorporates a catalytic conversion of CO to CH4 (methane). The samples are concentrated prior to introduction to the chromatographic system. The volatile hydrocarbons are extracted from the seawater by the use of a helium flow stream and concentrated on dry ice-acetone cold traps. Air samples can be processed in a similar way.

8029 **(BFE—2) Content of minerals and trace elements in meals.** Bognar, A.; Schelenz, R.; Gruenewald, T.; Frahm, H.; Heine, K.; Wiechen, A. (Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)). Jul 1981. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750433.

Within the frame work of the research programme 'School Feeding', 68 menu items of different producers were investigated for the content of the minerals calcium, chlorine, iron, potassium, magnesium, sodium and phosphorus, and for the trace elements antimony, barium, bromine, cesium, chromium, hafnium, iridium,cobalt, copper, manganese, mercury, rubidium, scandium, selenium, silver, strontium, tin and zinc. For the analytical determination of the elements, instrumental neutron activation analysis and X-ray fluorometry were applied. The studies showed that a calculation of the content of minerals and trace elements in meals on the basis of recipes and nutritive tables for raw foods is not justified, expect for sodium and phosphorus, because incorrect results can be obtained for the majority of meals.

8030 **(DOE/MC/16513—1249) Chemical separation, purification, and identification of EOR-active compounds in water-soluble petroleum sulfonate. Final progress report.** Chettur, G.; Rajan, K.S. (IIT Research Inst., Chicago, IL (USA)). Jul 1982. Contract AC21-81MC16513. 114p. NTIS, PC A06/MF A01. Order Number DE83003745.

Portions of document are illegible. Printed copy available until stock is exhausted.

Prior work carried out at the US Department of Energy's Energy Technology Center at Morgantown, West Virginia had indicated that when the commercial petroleum sulfonates i.e., Pyronate-40 or NBS is used for tertiary oil recovery, the components responsible for enhanced oil recovery constitute only a minor fraction of the complex mixture. The aim of our investigation was to fractionate one such complex petroleum sulfonate i.e., Pyronate-40, to a stage of purification and to undertake investigations for characterizing the chemical structures of the most active fractions. The most EOR-active fraction of the Pyronate-40 from the Florisil column separation step was subjected to GC/MS characterization. It was found that the methylesters of Pyronate-40 did not lend themselves to the GC/MS examination. The Pyronate-40 fractions were therefore desulfonated and the oil that distilled at 210 to 215°C was used for the GC/MS analysis. The major species in this oil was found to be structurally similar to the hydrocarbon obtained from Texas-57 under identical conditions of desulfonation and distillation. A re-examination (by Capillary GC) of the EOR-active fraction obtained from a replicate Pyronate-40 fractionation study indicated that, in addition to the Texas-57 type of species, it contained a number of other compounds. In a separate series, NBS (a detergent alkylate sulfonate) was fractionated under conditions identical to those of Pyronate-40 fractionation on Florisil and the EOR-active fraction was desulfonated and distillated. The oil when examined by means of capillary GC (with flame ionization detector) showed a very complex pattern, although it included a Texas-57 type species as a prominent component.

8031 (DOE/OR/05105—T1, pp 31-41) **Feasibility of separation processes in liquid-liquid solid systems: free energy and stability analysis.** Jacques, M.T.; Hovarongkura, A.D.; Henry, J.D Jr. (West Virginia Univ., Morgantown). 1980. NTIS (US Sales Only). Contract AS05-76OR05105.

In Development of a process for ash removal from coal-derived liquids based on particle distribution to an aqueous phase. Final report, March 1, 1976-June 30, 1980.

The feasibility of new solid/liquid separation processes, such as solids removal from oil and certain tertiary oil recovery techniques, can be evaluated by a thermodynamic stability analysis of possible liquid-liquid-particle configurations. The thermodynamic stability and hence feasibility of two possible liquid-liquid-particle separation process is predicted by use of a free energy analysis. Stability is shown to depend primarily on droplet/particle size ratio (n) and three phase contact angle (Θ). Stability criteria are presented which can be applied to many particle and liquid separation processes.

8032 **(GKSS—82/E/9) Study of optical emission spectroscopy with inductively coupled plasma torch.** Bauer, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1982. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750961.

Inductively coupled plasma optical emission spectroscopy is an excellent tool for quantitative multielement trace analysis. This paper describes the performance of a computer-controlled sequential measurement system. Chemical and ionization interferences are shown to be negligible due to the characteristics of the inductively coupled plasma, spectral interferences are eliminated by using a high-resolution monochromator and computer data handling. Good accuracy is achieved for most of the interesting elements, as is shown from both an interlaboratory test and from comparison of the results of water samples from the rivers Elbe and Weser with those achieved with neutron activation and X-ray fluorescence analysis.

8033 **(IAEA-RL—91) Report on intercomparison V-8 of the determination of trace elements in rye flour.** Pszonicki, L.; Veglia, A.; Dybczynski, R.; Suschny, O. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). Jan 1982. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702898.

The participants were requested to determine as many elements as they could from among the following 29: As, Be, Ca, Cd, Cl, Co, Cr, Cu, F, Fe, Ga, Hg, I, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, Tl, U, V and Zn. While six of these elements (Be, Ga, Sn, Tl, U, V) were not determined by any laboratory, some participants on the other hand determined several elements which had not been ordered for such as As, Al, Au, Ba, Br, Cs, Eu, La, N, Rb, S, Sc, Sr, Ti and Y. In total, 34 laboratories submitted results of 1,207 individual determinations (301 laboratory means) on 38 elements. The methods most often employed in this intercomparison were neutron activation analysis (47% of all results) and atomic absorption (20%). The results of the intercomparison demonstrated again the difficulties in the determination of trace elements in organic materials. The agreement between participating laboratories was in general poor.

8034 **(IAEA-RL—94) Report on intercomparison W-3/1 of the determination of trace elements in water.** Pszonicki, L.; Veglia, A.; Suschny, O. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). May 1982. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82702899.

Sixty-one laboratories submitted results of the determination of 17 trace elements in a simulated sample of fresh water. More than 40% of all results were obtained by a direct analysis of the sample without using any separation or preconcentration methods. Atomic absorption spectroscopy, particularly its flameless variant, was most frequently used for the determination. It was followed by neutron activation analysis, X-ray fluorescence and atomic emission spectroscopy. The results indicated that a correct determination of trace elements in water at the ppb (μg/l) level was still a difficult problem for many laboratories which were routinely engaged in this work.

8035 (IKF—41, pp 57-59) **Measurements of the hydrogen content in carbon foils.** Wirth, H.; Baumann, H.; Bethge, K.; Rauch, F.; Reeh, W.; Stiehl, H. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

The hydrogen content of carbon stripper foils produced by a sputtering or a cracking technique has been determined by a nuclear resonance reaction. H-contents of several ten atom percent have been measured. A release of H-atoms has been observed under the influence of the ion beam.

8036 (IKF—41, pp 68-69) **Activation analysis with ^{3}He ions for the determination of oxygen and carbon.** Bass, R.; Essl, H.; Kohlhase, R.; Weniger, R. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8037 (IKF—41, pp 69-70) **Determination of carbon and oxygen profiles using the reactions $^{12}C(d,p)^{13}C$ and $^{16}O(d,p)^{17}O$.** Bass, R.; Weniger, R. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8038 (IKF—41, pp 98-99) **Element analysis of tropospherical aerosol particles as function of the height by PIXE.** Metternich, P.; Georgii, H.W.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8039 (IKF—41, pp 100) **Reverse osmosis as method for the upconcentration of liquid samples.** Zepf, B.M.; Metternich, P.; Latz, R.; Hofmann, D.; Groeneveld, K.O.; Georgii, H.W. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8040 (IKF—41, pp 101) **Element analysis of natural precipitations by PIXE.** Zepf, B.M.; Metternich, P.; Latz, R.; Hofmann, D.; Georgii, H.W. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8041 (IKF—41, pp 102) **Half-micro analysis by PIXE.** Rohrbach, E.P.; Groeneveld, K.O.; Koenig, K.H. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8042 (IKF—41, pp 105-106) **Series studies of bronze age metal objects by neutron activation analysis.** Jockenhoevel, A.; Rossberg, D.; Wolf, G. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8043 **(INIS-mf—7134) Programme of VIIth seminar on extraction methods in chemistry.** (Ceskoslovenska Akademie Zemedelskych Ved, Prague. Ceskoslovenska Spolecnost Chemicka). [nd]. 32p. (In Czech). (CONF-8005226—Summ.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83780048.

From 7. seminar on extraction methods in chemistry; Cikhaj, Czechoslovakia (14 May 1980).

Individual papers are indexed separately.

8044 **(JAERI-M—9649) Chart of nuclides relating to neutron activation. Second edition.** Okada, M. (Japan Atomic Energy Research Inst., Tokyo). Sep 1981. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702896.

This chart is for frequent use in the prediction of the product species of neutron activation. The first edition of the chart has been made in 1976 after the repeated trial preparation. It has the following good points. (1) Any letter in chart is as large as one can read easily. [This condition has been obtained by the selection of items to be shown in chart. They are the name (the symbol of element, mass number, and half-life) of nuclide or of isomer, and the type of decay.]. (2) Decay product has been shown indirectly for branchings with two-step decay via short-lived daughter in an excited state. [This matter has been realized by use of the new mode of indication.] (3) Nuclides shown in chart are (a) naturally occurring nuclides and (b) nuclides formed from naturally occurring nuclides through one of the following reactions: (n, γ), (n, n'), (n, p), (n, α), (n, 2n), (n, pn), (n, 3n), (n, αn), (n, t), (n, ^{3}He), (n, 2p), and (n, γ)(n, γ). In the revision of the first edition, some modes of indication have become a little simpler, and the isomers of shorter half-lives (0.1 - 1 μs) have been added.

8045 **(JINR—6-81-619) Determination of microelement content in natural waters by X-ray fluorescence and activation analyses after preliminary concentration.** Drobina, T.P.; Langrok, Eh.; Brukhertzajfer, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1981. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702900.

Submitted to the journal Analiticheskaya Khimiya.

The technique of analysis of natural waters which differ in the mineralization level for determining Mn, Fe, Cu, Zn, As, Tl, Bi, Cd, Ag, In, Pb microimpurities is proposed. To improve the analysis sensitivity preliminary concentration by means of evaporation and extraction of microcomponents by chloroform and extracting them in an organic phase in a form of diethyl-dithiocarbamate complexes have been carried out. Most microimpurities have been determined by means of the X-ray fluorescence analysis method in concentrates which provides sensitivity from 10^{-3} to 10^{-2} mg/l. The Tl and Pb content is determined by the gamma activation analysis. The determination sensitivity constitutes $3x10^{-3}$ mg/l. The technique may be recommended for serial analysis.

8046 **(KFK-AFR—003, pp 41) Proton-induced X-ray emission (PIXE), a microanalytical method to determine element concentrations in thin sample materials.** Richter, F.W.; Waetjen, U. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8047 **(KFK-AFR—003, pp 45) Determination by activation analysis of Li, B, and N using ^{7}Be as tracer nuclide.** Sastri, C.S.; Caletka, R.; Krivan, V. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8048 **(KFK-AFR—003, pp 4) On-stream SiO_2 analysis in iron ore slurries.** Braun, H.; Riffel, F. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8049 **(KFK-AFR—003, pp 5) Process control with ^{252}Cf in the hard coal industry.** Wilde, H.R.; Herzog, W. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8050 **(KFK-AFR—003, pp 6) Determination of sulphur in brown coal with the aid of prompt (n,γ) radiation using ^{252}Cf as a neutron source.** Dammermann, H.; Halwachs, W.; Schuegerl, K. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8051 **(KFK-AFR—003, pp 8) Activation analysis with ^{3}He ions in order to determine C, N, and O in high-purity materials.** Bass, R.; Essl, H.; Weniger, R. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8052 **(KFK-AFR—003, pp 10) Determination of pigment distributions in solids with the aid of neutron activation and autoradiography.** Krassowski, G.; Mennig, G.; Hoffmann, P. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8053 **(KFK-AFR—003, pp 11) Fast radiochemical multielement neutron and proton activation analysis of high-purity niobium.** Faix, W.G.; Caletka, R.; Krivan, V. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8054 **(KFK-AFR—003, pp 24) Determination of trace elements in airborne dust by means of neutron activation analysis, X-ray fluorescence analysis, and atomic absorption. Critical comparison.** Voigt, R.; Lieser, K.H. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8055 **(KFK-AFR—003, pp 26) Development of multielement methods for analysis of trace amounts of elements in aerosols on the basis of NAA and total-reflection X-ray fluorescence analysis.** Knoechel, A.; Ketelsen, P. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8056 **(KFK-AFR—003, pp 43-44) Radiometric determination of material components using Compton and Rayleigh scattering.** Kuehn, W.; Georgi, B.; Garzke, T. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8057 **(KFK-AFR—003, pp 1) Time-of-residue measurements with radionuclide tracers in gas-solid reactors. Comparison between rotary tube, fluidized bed, and circulating fluidized bed.** Kroeger, H.; Rues, M.; Wippern, D.; Wittmann, K.; Helmrich, H.; Schuegerl, K. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8058 **(KFK-AFR—003, pp 2-3) Radionuclide investigations of the effects of mixed-space geometry on solid transport in a continuous plough share mixer.** Merz, A.; Holzmueller, R. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8059 **(KFK-AFR—003, pp 16) Mobile X-ray fluorescence with ^{109}Cd excitation for multi-element analyses of geological and mineralogical samples.** Hofmann, T.; Lieser, K.H.; Hoffmann, P. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8060 **(KFK-AFR—003, pp 17-18) Application of radionuclide X-ray fluorescence analysis as a multi-element field method in geochemical prospection.** Kramar, U.; Puchelt, H. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8061 **(KFK-AFR—003, pp 42) Trace element analysis using total-reflection RFA.** Schwenke, H.; Knoth, J. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8062 (KFK-AFR—003, pp 25) **Trace element determination in precipitated dust and aerosols using the PIXE method of analysis.** Richter, F.W.; Waetjen, U. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8063 (KFK-AFR—003, pp 32) **Application of tracer techniques to check the atomisation program for systematic errors in lead monitoring by means of flameless atomic absorption spectrometry.** Krivan, V.; Schmid, W. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8064 (LUTFD2/TFKF—1003/1-105/(1982)) **Applications of particle induced X-ray emission analysis to ambient aerosol studies. Long range transport, composition and sources.** Lannefors, H. (Lund Univ. (Sweden). Dept. of Nuclear Physics). 23 Apr 1982. 122p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE82702901.

Contains 5 papers.

The characteristics of Particle Induced X-ray Emission (PIXE) analysis in conjunction with different ambient aerosol samplers have been studied. Correction factors have been calculated for homogeneous and inhomogeneous rural and urban aerosol samples. The Nuclepore two stage filter sampler provided the most useful combination of the resolution and particle size fractionation in urban, rural and remote environments. The PIXE-analysis technique in combination with different samplers was employed in aerosol composition studies in rural and remote environments. Particular emphasis was laid on studies of aerosol long range transport. Based on air mass trajectory analysis and aerosol composition measurements the foreign contribution in southern Sweden was estimated to be 70 - 80% for S and Pb but only 30 - 50% for V and Ni. The spatial and temporal extension of a long range transport episode was studied using high time resolution continuous filter samplers in a network in southern Sweden. The variation in the concentration levels of sulphur agreed well with changes in the air mass history. Arctic summer elemental concentration levels as measured during the Swedish YMER-80 icebreaker expedition were typically one order of magnitude lower than Arctic winter levels. The combination of chemical information, optical properties and size distribution data supports the hypothesis of long range transport of air pollution into the Arctic especially during the winter. This takes place during the winter season because the Polar front is further south making conditions for long range transport up to the Arctic more favourable.

8065 (MLM—2948) **Determination of radionuclides in drinking water by gamma spectrometry: an interlaboratory collaborative study.** Casella, V.R.; Bishop, C.T. (Mound Facility, Miamisburg, OH (USA)). 12 Aug 1982. Contract AC04-76DP00053. 54p. NTIS, PC A04/MF A01. Order Number DE82020609.

Four reference samples, containing three or all four gamma emitters, ^{60}Co, ^{106}Ru, ^{134}Cs, and ^{137}Cs, from 6 to 400 pCi/L, were prepared and analytical results from 32 participating laboratories evaluated. Coefficients of variation for repeatability (within-laboratory precision), reproducibility (the combined within- and between-laboratory precision), and accuracy were determined. Results were evaluated at concentrations from twice to one tenth the maximum contaminant levels for ^{60}Co (100 pCi/L), ^{106}Ru (30 pCi/L), ^{134}Cs (80 pCi/L), and ^{137}Cs (200 pCi/L). Coefficients of variation were higher for the lower concentration samples. Ranges of the coefficients of variation for repeatability, reproducibility, and accuracy over the concentrations studied were, respectively, 3 to 12, 6 to 23, and 100 to 119% for ^{60}Co; 19 to 27, 28 to 49, and 101 to 182% for ^{106}Ru; 5 to 30, 9 to 30, and 92 to 99% for ^{134}Cs; and 2 to 10, 5 to 10, and 6 to 14% for ^{137}Cs. Larger errors were observed for ^{106}Ru. A negative bias of about 10% was observed for ^{134}Cs. Average lower levels of detection were estimated for ^{60}Co, ^{106}Ru, ^{134}Cs, and ^{137}Cs to be 7 pCi/L, 44 pCi/L, 8 pCi/L, and 7 pCi/L, respectively.

8066 (MLM—3015(OP)) **Comparison study of analytical methods for the determination of fluoride, chloride, and bromide in plastics.** Nunn, E.B.; Hale, M.D.; Kinard, C.; Preston, W.M. (Mound Facility, Miamisburg, OH (USA)). 1982. Contract AC04-76DP00053. 2p. (CONF-821038—5). NTIS (US Sales Only). Order Number DE83001534.

From 10. annual DOE compatibility conference; Albuquerque, NM, USA (26 Oct 1982).

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Ion chromatography, gravimetry, and colorimetry were compared. Ion chromatography was found to be faster, and to produce greater precision. (DLC)

8067 (SAND—82-1929) **Ion chromatographic procedures for the analysis of ethanol/ammonium tartrate anodization electrolyte.** Merrill, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1982. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01. Order Number DE83003836.

A solution which is 98% ethyl alcohol saturated with ammonium tartrate (0.12 gm/L) is used as an electrolyte in the formation of anodic aluminum oxide barrier film capacitor dielectrics. Bath composition affects the dielectric strength and thickness of these films. Anions in the electrolyte may cause poor barrier coatings by migrating to the aluminum anode and forming porous films or providing pathways for electrical breakdown. Ion chromatography has been found to be an ideal tool for both qualitative and quantitative analysis for anions in the anodization baths. A method for replacing the ethanol solvent with standard anion eluent prior to analysis was developed and used to analyze for chloride in the range of 0.05 to 1.0 μg/mL. The formation of formate and acetate ions in the electrolyte solution as a function of anodization was discovered during the course of these studies. Ion chromatography exclusion can simultaneously determine these two ions as well as tartrate ion without prior removal of ethanol, and can be used to monitor changes in bath composition. The ammonium ion can be analyzed in solutions by direct injection onto the cation chromatography columns. Procedures for the ion chromatographic determination of these ions are detailed. 9 figures, 4 tables.

8068 (STUDSVIK-NW—81/166) **Determination of the amount of ion exchange resin in concrete containing radioactive wastes.** Broden, K.; Sjoeblom, R. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 18 Dec 1981. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702904.

A method for determining the amount of ion exchange resin in waste concrete was tested on a (approximately 2 g) piece of concrete containing a known amount of ion exchange resin. The difference between the reference and the analysis values was less than ten per cent, and it seems likely that the reproducibility is considerably better. It was concluded that the method is suitable for homogeneity determinations, although some further experiments are needed before it can be used as a standard method.

8069 **Method and apparatus for electrostatically sorting biological cells.** Merrill, J.T. (to Department Of Energy). US Patent 4,347,935. 7 Sep 1982. Filed date 16 May 1979. vp.

PAT-APPL-039527.

An improved method of sorting biological cells in a conventional cell sorter apparatus includes generating a fluid jet containing cells to be sorted, measuring the distance between the centers of adjacent droplets in a zone thereof defined at the point where the fluid jet separates into descrete droplets, setting the distance between the center of a droplet in said separation zone and the position along said fluid jet at which the cell is optically sensed for specific characteristics to be an integral multiple of said center-to-center distance, and disabling a charger from electrically charging a specific droplet if a cell is detected by the optical sensor in a position wherein it will be in the neck area between droplets during droplet formation rather than within a predetermined distance from the droplet center.

8070 **Electrochemical photocapacitance spectroscopy - a new method for characterization of deep levels in semiconductors.** Haak, R.; Ogden, C.; Tench, D. (Rockwell Int, Thousand Oaks, CA, USA). *Journal of the Electrochemical Society;* 129: No. 4, 891-893(Apr 1982).

Electrochemical photocapacitance spectroscopy (EPS) offers advantages over similar solid-state photocapacitance spectroscopic techniques. In the EPS method, the capacitance of a reverse-biased semiconductor electrode is measured as a function of the wavelength of incident sub-bandgap light. In the present work, EPS is shown to be an extremely sensitive means for characterizing deep levels in semiconductor materials. For horizontal Bridgeman-grown n-GaAs, a hole trap, the chromium phototransition, and two electron traps were detected. The energies and densities of states for these levels correspond well with values reported in the literature for solid-state studies of similar materials. 21 refs.

8071 **A mass spectrometric determination of trace elements in aqueous media without preconcentration.** Foss, G.O. Ames, IA; Iowa State Univ. (1981). 106p. University Microfilms Order No.81-28816.

Thesis (Ph.D.).

The feasibility of using a low pressure glow discharge as an ion source for the mass spectrometric determination of trace elements in aqueous media was investigated. A cryogenically cooled hollow cathode ion source was developed to analyze aqueous samples without external preconcentration. Aqueous solutions containing seventy elements were analyzed and the detection limits, sensitivity factors, and linear regression correlation coefficients were determined.

8072 **IUPAC reference method for analysis of nickel in serum and urine by electrothermal atomic absorption spectrometry.** Brown, S.S. (MRC Clinical Reseach Centre, Harrow, England); Nomoto, S.; Stoeppler, M.; Sunderman, F.W. *Pure and Applied Chemistry;* 53: 773-781(1981). Contract AC02-76EV03140.

A reference method for analysis of nickel in blood serum and urine has been developed by the IUPAC subcommittee on Environmental and Occupational Toxicology of Nickel to promote the international standardization of nickel determinations in body fluids. The principle of the method and procedure are outlined in detail. A description of the necessary reagents, calibration solutions, and quality control preparations is given. (KRM)

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 6949, 7076, 7083, 7084, 7094, 7182, 7838, 7913, 7963, 8010, 8154, 8498

8073 **(AD-A—114572/1) A microscopic model for catalyst surfaces. ii. supported catalysts. Technical summary report.** Jensen, K.F.; Ray, W.H. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Feb 1982. 76p. NTIS, PC A05/MF A01.

A new 'pebbly surface' model of supported metal catalysts is presented which can explain observed multiplicity and oscillatory behaviour of catalyst particles. This model combines the dynamic behaviour of the individual metal crystallites on the surface of the support with diffusion and heat transfer processes in the porous particle. The bifurcation of oscillations is analyzed in terms of relaxation oscillations as well as by Hopf's theorem and it is shown how the bifurcation phenomena depend on the system parameters. The parameter study may be used to suggest operating conditions and catalyst design parameters such that sintering effects may be reduced. Qualitative comparisons with data for carbon monoxide oxidation at various temperatures show very good agreement; however, this present simple form of the pebbly surface model seems unable to predict the long period oscillations observed in hydrogen oxidation.

8074 **(DESY-SR—81/02) EXAFS study of the structure of Co-Mo hydrodesulfurization catalysts.** Clausen, B.S.; Topsoe, H.; Candia, R.; Villadsen, J.; Lengeler, B.; Als-Nielsen, J.; Christensen, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1981. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750351.

By analysing the extended X-ray absorption fine structure (EXAFS) of the Mo absorption edge, structural information about both calcined and sulfided Mo/Al_2O_3 and $Co\text{-}Mo/Al_2O_3$ catalysts has been obtained. The calcined catalysts show only one strong backscatterer peak in the radial distribution function, which indicates that molybdenum is present in a highly disordered structure. For the $Co\text{-}Mo/Al_2O_3$ catalyst the presence of cobalt seems to have some effect on the immediate surroundings of molybdenum. Upon sulfiding the catalysts, an ordering of the molybdenum-containing phase takes place as evidenced by the observation of a contribution from the second coordination shell. From a comparison with EXAFS data obtained on well-crystallized MoS_2 it is concluded that the molybdenum atoms in the catalysts are present in MoS_2-like structures. Furthermore, from a comparison of the amplitude of the Mo-backscatterer peak it is found that these MoS_2-like structures are ordered in very small domains.

8075 **(DOE/ER/04254—5) Properties of supported metal catalysts. Summary progress report.** Butt, J.B.; Burwell, R.L. Jr.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA)). Oct 1982. Contract AC02-77ER04254. 34p. NTIS, PC A03/MF A01. Order Number DE83002790.

Portions of document are illegible.

This report reviews work accomplished during the past three years. The following topics are discussed: history of the project; scientific background; preparation of Pd/SiO_2 catalysts; surface chemistry; wide angle x-ray scattering (WAXS), small angle x-ray scattering (SAXS), extended x-ray absorption fine structure (EXAFS); isotopic exchange between deuterium and cyclopentane; isotopic exchange between deuterium and neohexane; hydrogenolysis of methylcyclopropane; hydrogenation of propylene; cobalt-rhodium/silica gel. Summary and conclusions as well as some residual problems are presented. 7 figures, 2 tables. (ATT)

8076 **(IAEA-R—2044-F) Programme study of the complex formation processes in aqueous solutions - correlation between the stability constants of metal complexes. Part of a coordinated programme on thermodynamic and transport properties of nuclear materials. Final report for the period 1 September 1977 - 30 September 1981.** Mihailov, M.H. (International Atomic Energy Agency, Vienna (Austria)). Mar 1982. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE82702902.

A standard polarographic method was used to determine the formation curve for species in the cadmium-formate complex system. A semi-empirical correlation was established between the stability constants for the step-wise complexation reactions as follows: sup(β)n=A.asup(n)/n factorial. The stability constants were determined by an iterative procedure both with the constraint that the constants should be correlated and without this constraint. The resulting constants were used to calculate predicted formation curves which were then compared statistically with the measured curve and standard deviations determined. The same correlation was used to analyse published data on the glycolate complexes of the rare earths and the calculated stability constants compared with those published previously. In all cases the stability constants derived using the above correlation gave a satisfactory fit to the measured data. The fit was comparable to, though not usually as good as, that obtained by a more rigorous treatment of the data which does not assume that the constants are correlated. This correlation permits estimates to be made of the values of stability constants of higher complexes in a given metal-ligand system and to calculate the formation curve for all species if the stability constants of the first two complexes are known.

8077 **Method for synthesizing boracities.** Wolf, G.A. (to Department Of Energy). US Patent 4,353,884. 12 Oct 1982. Filed date 9 Oct 1981. vp.

PAT-APPL-310247.

A method for producing boracites is disclosed in which a solution of divalent metal acetate, boric acid, and halogen acid is evaporated to dryness and the resulting solid is heated in an inert atmosphere under pressure.

8078 **Gas-phase ion-molecule reactions of Fe^+ and Ti^+ with alkanes.** Byrd, G.D.; Burnier, R.D.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **104**: No. 13, 3565-3569(30 Jun 1982).

A pulsed laser has been used in conjunction with an ion cyclotron resonance mass spectrometer to generate and study the gas-phase ion-molecule reactions of Fe^+ and Ti^+ with a series of alkanes. While C-C insertion leading to alkane elimination and C-H insertion leading to H_2 elimination are competitive in the Fe^+-alkane system, the Ti^+-alkane system is dominated by C-H insertions. Ti^+ also tends to release multiple neutrals from the initial collision complex to create multiple sites of unsaturation in the bound hydrocarbon. The C-C insertions by Fe^+ are somewhat selective for the weaker bonds in the alkane.

8079 **Approximate quantum differential cross section for the F + HD → HF + D and DF + H reactions.** Lee, K.T.; Bowman, J.M. (Illinois Inst. of Tech., Chicago). *Journal of Physical Chemistry;* **86**: No. 13, 2289-2291(24 Jun 1982). Contract AC02-81ER10900.

In a previous paper we proposed a novel way to obtain approximate quantum mechanical differential cross sections. Here, we use this approximate method to study the reactions F + HD(nu = 0) → FH(nu′ = 2) + D and F + DH(nu = 0) → DF(nu′ = 3) + H. Backward and forward scattering are found for the first reaction and only backward scattering for the second one. These results agree qualitatively with experiment. 1 figure.

8080 **Gas-phase reactions of O^- and O_2^- with a variety of halogenated compounds.** Streit, G.E. (Los Alamos Scientific Lab., NM). *Journal of Physical Chemistry;* **86**: No. 13, 2321-2324(24 Jun 1982).

The flowing afterglow technique has been applied to a comparative study, for a series of halogenated compounds, of dissociative attachment and reaction with O^- and O_2^- overlaps but is more diverse than that obtained by dissociative attachment. Absolute rate constants for the O^- and O_3^- reactions are reported. A few reactions, for which exothermic mechanisms can be written, were found to be quite inefficient. 3 tables.

8081 **Silicon tetrafluoride generation.** Hansen, K.C.; Yaws, C.L. (to Dept. of Energy). US Patent Application 345,458. 3 Jan 1982. 23p.

This invention is directed to a process of generating silicon tetrafluoride (SiF_4) from aqueous solutions of hexafluorosilicic acid (H_2SiF_6), comprising reacting an aqueous solution of H_2SiF_6 with a concentrated aqueous salt solution to produce a precipitate, separating and drying the precipitate, and heating the precipitate in an inert atmosphere to decompose the precipitate producing SiF_4.

8082 **Influence of impurities on high-temperature reactions of kaolinite.** Johnson, S.M.; Pask, J.A.; Moya, J.S. (Univ of California, Berkeley, USA). *Journal of the American Ceramic Society;* **65**: No. 1, 31-35(Jan 1982).

When kaolinite is heated for differential thermal analysis (DTA) the second exothermic peak (/approximately equals/1275/degree/C) is due to the growth of mullite crystals accelerated by the formation of a liquid phase. The third exothermic peak (/approximately equals/1460/degree/C) is due to the crystallization of cristobalite. The addition or presence of impurity oxides causes the second peak to shift in temperature and accelerates the formation of cristobalite so that the third peak may appear as low as the second exothermic peak temperature. 12 refs.

8083 **Correlation effects in diffusion in a two sublattice structure.** Murch, G.E. (Argonne Natl Lab, IL, USA). *Journal of Physics and Chemistry of Solids;* **43**: No. 3, 243-247(1982).

With a Monte Carlo method the author has investigated tracer and conductivity (physical) correlation factors in the simple cubic lattice gas with two fcc inequivalent sublattices and self exclusion by the atoms. Except at very low temperatures, excellent agreement was found between our results for the conductivity correlation factor and Richard's approximate treatment. At an occupation of 0.5 the Haven Ratio exhibits the characteristic discontinuity found recently in other lattice gases which give ordered arrangements. On the concentration axis at low temperature another discontinuity in the Haven Ratio was found. All of these discontinuities are associated with changes in mechanism. 18 refs.

8084 **Effect of association of defects on the thermodynamic factor for diffusion.** Osenbach, J.W.; Bitler, W.R.; Stubican, V.S. (Pennsylvania State Univ, University Park, USA). *Journal of Physics and Chemistry of Solids;* **43**: No. 4, 413-414(1982).

A comparison of the atomistic model describing the diffusion behavior of aliovalent ions in an ionic lattice with the thermodynamic description of diffusion reveals that everything included in the thermodynamic factor is present in the atomistic model if ideal behavior is assumed. It is shown that in the limit of dilute solution the thermodynamic factor is equal to 3/2 if monomers are the diffusion species, 2 if dimers are the diffusing species, or 3 if trimers are the diffusing species. These results are consistent with the atomistic model. 5 refs.

8085 **The synthesis and characerization of some binary and ternary zirconium iodides.** Guthrie, D.H. Ames, IA; Iowa State Univ. (1981). 120p. University Microfilms Order No.81-28822.

Thesis (Ph.D.).

An investigation into the binary ZrI_4-Zr and ternary CsI-Zr-ZrI_4 systems has produced several new compounds which were synthesized via high temperature techniques and characterized by x-ray diffraction. The new binary compounds include two polymorphs of ZrI_2 (α and β) an well as a new understanding of a phase described earlier as "ZrI/sub 1.8/"-α-ZrI_2 forms as black lath-like crystals by vapor phase tranport reactions between Zr and ZrI_4 from 700 to 825°C.

8086 **Some reduced ternary and quaternary oxides of molybdenum containing strong metal-metal bonds.** Torardi, C.C. Ames, IA; Iowa State Univ. (1981). 179p. University Microfilms Order No.81-28865.

Thesis (Ph.D.).

Several new, reduced ternary and quaternary oxides of molybdenum are reported, each containing molybdenum in an average oxidation state <4.0. All of these compounds contain either discrete molybdenum atom clusters or infinite chains of bonded molybdenum atoms. The compounds $ScZnMo_3O_8$, $LiZn_2Mo_3O_8$, and $Zn_3Mo_3O_8$ have been synthesized and crystal structures have been determined for the latter two.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 6960, 8075, 8075, 8078, 8080, 8098, 8099

8087 **(DOE/ER/02945—6) Continuous-chemical-reaction chromatography. Progress report, January 1, 1982-October 31, 1982.** Aris, R.; Carr, R.W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1982. Contract AC02-76ER02945. 18p. NTIS, PC A02/MF A01. Order Number DE83002777.

Portions of document are illegible.

A detailed study of the mathematical model describing the behavior of a chromatographic moving bed reactor has been completed. Experiments have been done resulting in the selection of the hydrogenation of mesitylene as the model reaction to be used in the laboratory scale chromatographic moving bed apparatus. Some considerations of residence time distributions in countercurrent systems have been addressed.

8088 **(Juel-Spez—139) Investigation of the influence of periodic operation on the temperature profiles in fixed bed reactors.** Bremer, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jan 1982. 187p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750953.

Kinetic measurements of the heterogeneous katalytic oxidation of ethylene were carried out in a recycle reactor. This study investigates the reaction kinetics under normal pressure in a large area of interesting reactor concentrations and temperatures. Data were fitted to a Langmuir-Hinshelwood respectively to a Eley-Rideal-type model. A laboratory scale fixed bed reactor was constructed to determine axial and radial temperature profiles and axial concentration profiles under reaction condition. In this investigation the highly exothermic oxidation of ethylene over a supported silver catalyst was chosen as a model reaction. The voltage measurements of 60 thermocouples installed at different positions inside the tube and the continuous registration of reactor feed and reactor effluent by process-massspectrometry were performed by data acquisition system. To determine heat transfer data in the present fixed bed reactor, hot inert gas was conducted in the cold tube reactor, the stationary temperature profiles were measured and these data were fitted to analytical heat transfer equations. The ignition and extinction behaviour and the regions of multiplicity were determined under steady-state conditions. Hot-spot-temperatures were measured in the packed-bed reactor which were 400 K above the wall temperature. It was found that the existence of multiplicity could be suppressed by periodic operation, this means by periodically varied feed concentration of the reactants. Furthermore a higher selectivity of the reaction was favoured by periodic operation. The two-dimensional pseudo-homogeneous model has been used to simulate the fixed bed reactor under steady-state condition for ethylene oxidation.

8089 **Chirality and structures of bacteriochlorophylls d.** Smith, K.M. (Univ. of California, Davis); Goff, D.A.; Fajer, J.; Barkigia, K.M. *Journal of the American Chemical Society;* **104**: No. 13, 3747-3749(30 Jun 1982). Contract AC02-76CH00016.

Bacteriochlorophylls (BChl) c and d comprise two homologous series of chlorophylls found in the antenna and reaction centers of green sulfur bacteria (Chlorobiacae). Despite the continuing controversy concerning the structures of the six BChl c pigments, assignments of the BChl d, which lack the δ methine methyl substituent found in BChl c, have been generally accepted. It was recently deduced that the difference between pairs of BChl c lay in the asolute stereochemistry of the chiral 2-(1-hydroxyethyl) substituent; i.e., the bacteriopheophorbide bearing a 4-isobutyl and 5-ethyl was shown to have an S absolute stereochemistry, contrary to assignments of R for the complete mixture of pigments. This work reports that the 4-isobutyl-5-ethyl- and 4-isobutyl-5-methylbacteriopheophorbides also possess the 2-(S)-(1-hydroxyethyl) absolute configuration but that the other bacteriopheophorbides d (and presumably BChl d) exhibit the expected R stereochemistry. Bchl d were isolated from Chlorobium vibrioforme forma thiosulfatophilum; treatment of the crude chlorophyll extract with methnol and sulfuric acid gave the pheophorbides as an intimate mixture, the gross structures of which had been determined earlier by degradative and synthetic work. Lengthy high-pressure liquid chromatography work resulted in accumulation of preparative quantities of all six methylbacteriopheophorbides d. Nuclear magnetic resonance spectroscopy was used to confirm the configuration of BChl d.

8090 **On the mechanism of hydrogenolysis of linear hydrocarbons and its relationship to the Fischer-Tropsch reaction.** Osterloh, W.T.; Cornell, M.E.; Pettit, R. (Univ. of Texas at Austin). *Journal of the American Chemical Society;* **104**: No. 13, 3759-3761(30 Jun 1982).

The products from the reactions of n-octane and 1-octene with H_2 at low conversion over silica-supported Ni, Ru, and Co catalysts have been examined. In contrast to all previous studies, the α-olefin was included with the assumption that it would selectively afford an n-alkyl species. The hydrogenolysis of 1-octene or n-octane over Ni at 230° C produced n-alkanes exclusively. Two models of linear alkane hydrogenolysis have been proposed. The key feature of these models is the methylene deinsertion reaction, which represents a new mechanism for the catalytic cleavage of C-C bonds. The two mechanisms readily account for and are consistent with the experimentally observed distributions and suggest that the two schemes are plausible alternatives to currently accepted mechanisms.

8091 **Geometry of the nπ* states of p-benzoquinone. A comparison of valence-bond and configuration-interaction descriptions.** Martin, R.L.; Wadt, W.R. (Los Alamos Scientific Lab., NM). *Journal of Physical Chemistry;* **86**: No. 13, 2382-2387(24 Jun 1982).

The description of the nπ* excited states of p-benzoquinone by a configuration-interaction (CI) expansion based on symmetry-restricted molecular orbitals is compared to a valence-bond (VB) model based on a nonorthogonal two-configuration wave function utilizing broken-symmetry, self-consistent-field solutions. The former approximation is found to converge only very slowly to the latter. The valence-bond model was used to examine the potential energy surface for motion involving the symmetric and antisymmetric combinations of the two carbonyl stretches. The minimum in the symmetric stretch coordinate for both the ^{3}B/sub 1g/ and ^{3}A/sub u/ states is substantially longer than the ground-state distance. The surface along the antisymmetric stretch coordinate is very flat, but the calculations find no overwhelming evidence for a global C/sub 2nu/ minimum in the ^{3}B/sub 1g/ state. 3 figures, 6 tables.

8092 **Proton affinites of substituted benzaldehydes, 2-phenylpropenes (α-methylstyrenes), and related molecules: calculational studies and comparison with experimental data.** Greenberg, A. (New Jersey Inst. of Tech., Newark); Liebman, J.F. *Journal of Organic Chemistry;* **47**: No. 11, 2084-2088(21 May 1982).

Ab initio molecular orbital calculations, employing the STO-3G basis set, have been used to calculate proton affinities of substituted benzaldehydes and 2-phenylpropenes (α-methylstyrenes). The results are correlated with (an updated compendium of) Brown-Okamoto σ^+ values as well as with the Taft dual-substituent-parameters (DSP) equation. Comparisons are made with correlations of experimental gas-phase data. Comparisons of correlations of calculational and experimental data are made for benzenium and benzyl cations.

8093 **Synthesis and reactivity of 6-substituted (Z)-2-En-4-ynoic acids.** Struve, G.; Seltzer, S. (Brookhaven National Lab., Upton, NY). *Journal of Organic Chemistry;* **47**: No. 11, 2109-2113(21 May 1982).

Five different 6-substituted (Z)-2-en-4-ynoic acids (X = CH_3,CH_3CHOH, $CH_3C(=CH_2)$, CH_3CHOAc, CH_3CO have been synthesized. The first three were formed by coupling of methyl(Z)-3-iodopropenoate and the appropriate cuprous acetylide followed by ester hydrolysis. The latter two were obtained from the hydroxyl compound by acetylation and oxidation, respectively. Three of the five compounds were shown to undergo lactonization by nucleophilic addition of the carboxlate group to the acetylenic carbon to yield 4-alkylidene-2-butenolide derivatives with specific trans addition. The rate of lactonization for the title compound (X = CH_3CO) is too fast to measure. The kinetics of lactonization for X = CH_3CHOAc and CH_3CHOH have been measured in water and dimethylformamide. The observed rate ratio for lactonization suggests the possibility of electrophilic catalysis by the neighboring acetate group.

8094 **Two-photon absorption and nonlinear polariton effects in organic crystals.** Johnson, C.K. Ames, IA; Iowa State Univ. (1981). 177p. University Microfilms Order No.81-28830.

Thesis (Ph.D.).

Two-photon excitation (TPE) and second harmonic generation (SHG) have been studied in phenanthrene crystals at low temperatures (2 to 6K) in order to investigate mechanisms of two-photon absorption (TPA), the relationship between TPE and SHG, and polariton effects. The transition studied is of special interest because it is both one- and two-photon allowed in the dipole approximation. Consequently, polariton states and SHG play a role in the

two-photon process. In the polariton model, both TPA and SHG are understood as resulting from the process of polariton fusion.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 7786, 7787, 7871, 8080

8095 (LBL—14708) Use of a flow-through porous electrode for removal of mercury from contaminated brine solutions. Matlosz, M.; Newman, J. (Lawrence Berkeley Lab., CA (USA)). May 1982. Contract AC03-76SF00098. 14p. (CONF-820508—6). NTIS, PC A02/MF A01. Order Number DE83001895.

From Spring meeting of the Electrochemical Society; Montreal, Canada (9 May 1982).

Experiments conducted in this laboratory show that mercury-contaminated brine solutions can be purified by reduction of the mercury in a flow-through porous carbon electrode (fixed-bed electrochemical reactor). Diffusion-limited currents can easily be attained under potentiostatic operation, and mercury concentrations in 4 M NaCl solutions can be decreased, without serious side reactions, from 34 ppM to less than 5 ppB with flowrates as high as 12 bed-volumes per hour. These results indicate that a flow-through porous electrode may be an attractive processing alternative for contaminated brine solutions. In addition, the mercury system appears to be an ideal candidate for the general study of reactors of this sort. 7 figures, 2 tables.

8096 Electrochemical studies of the film formation on lithium in propylene carbonate solutions under open-circuit conditions. Geronov, Y.; Schwager, F.; Muller, R.H. (Lawrence Berkeley Lab, CA, USA). *Journal of the Electrochemical Society;* **129**: No. 7, 1422-1429(Jul 1982).

The nature of protective surface layers formed on lithium in propylene carbonate solutions of LiClO/sub 4/ and LiAsF/sub 6/ at open circuit has been investigated by electrochemical pulse measurements. The resuts are consistent with the fast formation of a compact thin layer resulting from the reaction with residual water. This layer acts as a solid ionic conductor. Slow corrosion or decomposition processes produce a thicker porous overlayer. 22 refs.

4005 Photochemistry

REFER ALSO TO CITATION(S) 7115, 8485

8097 (DOE/ER/12042—1) Unified approach to characterization of collisions between reactive radical pairs in solution. Technical progress report. (Brown Univ., Providence, RI (USA)). 1982. Contract AC02-82ER12042. 4p. NTIS, PC A02/MF A01. Order Number DE83003015.

Purpose of this program, initiated on March 15, 1982, is to study the interactions between organic free radicals .CH_2X in aqueous and organic solvents, using four methods: (1) kinetic EPR, (2) Heisenberg exchange rate measurements by means of pulsed EPR, (3) CIDEP, and (4) CIDNP. Progress to date is reported. No data is given. (DLC)

8098 Poly(pyridine)ruthenium(II)-photoinduced redox reactions of bipyridinium cations, poly(pyridine)rhodium complexes, and osmium ammines. Creutz, C.; Keller, A.D.; Sutin, N.; Zipp, A.P. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **104**: No. 13, 3618-3627(30 Jun 1982).

The quenching of $*RuL_3^{2+}$ (L is a 2,2'-bipyridine or 1,10-phenanthroline derivative) emissions by three classes of oxidants Q has been examined. The results are discussed in terms of the Marcus electron-transfer model recast in a preequilibrium formalism. Substituted bipyridinium cations (methyl viologen and related compounds) undergo thermodynamically favorable reduction with a driving force ranging from 0.1 to 0.7 eV and rate constants in the range (0.4-2.0) x 10^9 $M^{-1}s^{-1}$, consistent with a diffusion rate constant of 2.0 x 10^9 $M^{-1}s^{-1}$ and an exchange rate constant of $\sim 10^6$ $M^{-1}s^{-1}$ for the Q-Q couples. The yields of the separated redox products RuL_3^{3+} and Q^- (typically 0.1 mol einstein^{-1} per quenching act) require K_{30}, the "intramolecular" back-reaction rate constant (to re-form ground-state RuL_3^{2+} and Q), to be (2-4) x 10^{10} s^{-1}. Since K_{30} increases weakly with driving force in this series, there is no evidence for inverted behavior despite the fact the ΔG°_{30} is $\sim$-2 eV. With Q = $Rh(4,4'-(CH_3)_2bpy)_3^{3+}$, the quenching rate constants, k/sub q/ = (0.001-1.0) x 10^9 $M^{-1}s^{-1}$, exhibit a great sensitivity to the reducing power of $*RuL_3^{2+}$ and have been fitted to $k_{11} \approx 2$ x 10^9 $M^{-1}s^{-1}$ and E°/sub Q,Q⁻/ = -0.97 V for the RhL_3^{3+}-RhL_3^{2+} couple. This E° value is strikingly similar to that (-0.9 V vs. aqueous SCE) obtained via cyclic voltammetry in acetonitrile. The cyclic voltammetry of the RhL_3^{3+} complexes in water has been reexamined, and it is concluded that the irreversibility observed is due to ligand loss from rhodium(I).

8099 Deazaflavin photocatalyzed methyl viologen reduction in water. A laser flash-photolysis study. Visser, A.J.W.G.; Fendler, J.H. (Texas A and M Univ., College Station). *Journal of Physical Chemistry;* **86**: No. 13, 2406-2409(24 Jun 1982).

Photosensitized reduction of methyl viologen (MV^{2+}) by 2 x 10^{-4} 10-methyl-5-deazaisoalloxazine-3-propanesulfonic acid (dF) in the presence of 1 x 10^{-3}-10 x 10^{-3} M EDTA has been investigated in aqueous solutions by nanosecond laser flash photolysis. At substoichiometric concentrations of MV^{2+}, the reactions ^1dF (h nu)→ $^1dF^*$ (isc)→ $^3dF^*$; $^3dF^*$ + EDTA → $^2dF.$ + EDTA$^+$; $^2dF.$ + MV^{2+} → ^1dF + MV^+. have been discerned; thus dF acts as an electron relay. At higher MV^{2+} concentrations additional modes of dF catalyzed MV^+. formation become available. 5 figures, 2 tables.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 7853, 8097, 8233, 8234, 8410

8100 (INIS-mf—7138) Testing of bituminized ion-exchange resin waste products from a nuclear power plant. Muurinen, A.K.; Vuorinen, U.S. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). [nd]. 24p. (CONF-8109131—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702909.

From 2. IAEA research co-ordination meeting on the treatment of spent ion-exchange resins; Toronto, Canada (21 Sep 1981).

Testing methods are described and preliminary results are presented for the bituminized waste products from TVO nuclear power plant. Radiation effects on the physical and chemical characteristics of the waste product and a pure bitumen sample were studied using an external ^{60}Co gamma source. Results of the postirradiation study show that the relative density decreases for both the waste products and the bitumen. Softening points rise for waste products but drop for bitumen. Breaking point of the powder resin waste product drops; in the granular resin waste product it rises on the surface and slightly decreases or does not significantly change at the bottom. For bitumen the breaking point rises.

8101 (KFK—3124) Report on results of research and development work in 1980 of the Institute for Radiochemistry. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Feb 1981. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750671.

Reported are the investigations of the Institute with the main points of analysis, nuclear chemistry and water chemistry. The analytical and nuclear chemical topics are included in the projects PWA, PNS, PSB and KMUe. The KMUe-project is performed in close co-operation with the European Institute for Transuranic Elements. The analytical investigations concentrate on fuel- and burn-up tests, on analyses of epipolar rays and neutron activations as well as on methodical development and automation of test methods. The 'Isotope-place' does preparatory works and effects irradiations in the FR2, Cyclotron and Co-60-γ-source. The radiochemical group prepares weekly several hundreds of Curie fission molybdenum 99 for nuclear medical purposes. The institute-internal project 'Drinkwater treatment and technology' treats in close co-operation with the 'Engler-Bunte-Institute' the clearing of water impurities and the analytical determination of persistent noxious substances in waters like the Rhine, the Danube and the lake Constance.

8102 **(NSRDS-NBS—70) Rate constants for reactions of aliphatic carbon-centered radicals in aqueous solution.** Ross, A.B.; Neta, P. (Notre Dame Univ., IN (USA). Radiation Lab.). Oct 1982. Contract AC02-76ER00038. 101p. NTIS, PC A06/MF A01. Order Number DE83002794.

Rate constants have been compiled for reactions of various transient aliphatic radicals produced mostly by radiolysis in aqueous solutions. In certain cases the radicals have been produced by photolysis or by a thermal chemical reaction. Data are included for aliphatic carbon-centered radicals only, i.e. substituted alkyl radicals in the broad sense, but not for oxyl or aminyl radicals. Reactions of the aliphatic radicals with inorganic and organic compounds are included.

8103 **H_2 production in the $^7Li^{3+}$ ion radiolysis of benzene.** LaVerne, J.A.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* 86: No. 13, 2282-2284(24 Jun 1982).

The $^7Li^{3+}$ ion radiolysis of liquid benzene results in a substantial yield of H_2 (43,000 molecules/particle) above that produced in fast electron radiolysis. This excess hydrogen is produced predominantly in processes which occur very near the end of the track but while the lithium ion is still predominantly in the 3+ charge state. The differential yield decreases rapidly with increasing particle energy from a maximum of approx. 0.5 molecules/100 eV in the region of a few MeV where the linear energy transfer is approx. 40 eV/A and approaches the yield observed in electron radiolysis (0.04 molecules/100 eV) at energies above 25 MeV. The observed dependence suggests that the excess H_2 results primarily from intratrack reactions involving intermediates which decay in very rapid first-order processes. 1 figure.

8104 **Dynamic spectral shifts of molecular anions in organic glasses.** Huddleston, R.K.; Miller, J.R. (Argonne National Lab., IL). *Journal of Physical Chemistry;* 86: No. 13, 2410-2415(24 Jun 1982). Contract W-31-109-ENG-38.

Time-dependent spectra of the radical anions of pyromellitic dianhydride and p-dinitrobenzene have been observed after formation by pulse radiolysis in frozen 2-methyltetrahydrofuran and triacetin glasses. At temperatures near the glass transition, the spectra shift toward the blue over the entire observed time range 100 ns to 100 s), while at temperatures well below the glass transition, the spectral shifts can be stopped or greatly slowed. The magnitudes of the shifts are not large (typically approx. = to 10 nm), but because they are larger than the vibrational line widths, dramatic kinetics may be observed: the absorbance grows or decays by more than a factor of five at some wavelengths. The observations are consistent with a solvent molecule reorientation mechanism for spectral shifts of molecular ions in low-temperature organic glasses. 6 figures.

8105 **Pulse radiolysis investigation of the reactions of BrO_2. with $Fe(CN)_6^{4-}$, Mn(II), phenoxide ion, and phenol.** Field, R.J.; Raghavan, N.V.; Brummer, J.G. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* 86: No. 13, 2443-2449(24 Jun 1982).

The single-electron reductions of BrO_2. by $Fe(CN)_6^{4-}$, phenoxide ion, Mn(II), and phenol have been investigated. The BrO_2. was produced by pulse radiolysis of aqueous solutions of BrO_3^- which also contained one of these reductants. All experiments were carried out at pH 6-12. The reductions by $Fe(CN)_6^{4-}$ and phenoxide ion were rapid and clean and led to the products $Fe(CN)_6^{3-}$ and phenoxy radical. The rate constants for these reductions were found to be, respectively, (1.9 +- 0.1) x 10^9 and (2.6 +- 0.2) x 10^9 $M^{-1}s^{-1}$. The reductions of BrO_2. by Mn(II) and phenol were found to be much slower as well as more complex than the reductions by $Fe(CN)_6^{4-}$ and phenoxide ion. The products were, as expected, Mn(III) and phenoxy radical. However, there was a component of BrO_2. reduction by Mn(II) whose rate did not depend upon [Mn(II)]. Furthermore, the rate of BrO_2. reduction by phenol did not depend at all upon the concentration of phenol. It is suggested that these slower reductions were complicated by the well-known dimerization equilibrium between BrO_2. and Br_2O_4. If the rate of reduction of this dimer by Mn(II) or phenol is comparable to or faster than the rate of its return to BrO_2., then the dimerization process itself will become partially or completely rate determining. 8 figures, 1 table.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 7006, 7011, 7027, 8101, 8208

8106 **(HMI—347) Scientific progress report 1980. Reactor and nuclear chemistry department.** (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Kernchemie und Reaktor). [nd]. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE82750352.

This annual report contains extended abstracts about the results in research and technology concerning neutron scattering, radiation defects in solids, reactor chemistry, the study of trace elements in biomedical science, geochemistry, and reactor operation. Furthermore, a list of publications and speeches is given.

8107 **(IKF—41, pp 64-65) Elastic recoil detection (ERD) method as a procedure for the establishment of hydrogen and deuterium depth profiles.** Bluemner, S.; Rauch, F.; Baumann, H. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8108 **(K/OA—5330) Technical bases for using vapor-phase sampling to determine the UF_6 content of cylinders of liquid UF_6-HF.** Davis, W. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 22 Nov 1982. Contract W-7405-ENG-26. 62p. NTIS, PC A04/MF A01. Order Number DE83000344.

Portions of document are illegible.

This report describes a reanalysis of data on liquid-liquid and liquid-vapor equilibria in the system UF_6-HF, and the associated vapor pressures, and the applicability of these data to the use of analyses of vapor-phase samples for determining liquid-phase compositions; that is, determining the UF_6 content of the solution. Such use of vapor-phase sampling requires that: (1) UF_6 and HF be the only significant components present; (2) equilibrium between liquid and vapor phases exists during the sampling operation. The first specification does not mean the exclusion of tens of parts per million of nonvolatile corrosion products; instead, it refers to the absence of appreciable quantities of species in liquid and vapor phases that could change the equilibrium distribution of UF_6 and HF between these two phases. The present specification of liquid solution requires that the materials' temperature be above 61.2°C.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 7660, 7662

8109 **(AD-A—114477/3) Activation energy asymptotics applied to burning carbon particles. Technical summary report.** Kassoy, D.R.; Libby, P.A. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Jan 1982. 38p. NTIS, PC A03/MF A01.

The method of activation energy asymptotics is used to describe the entire history of a carbon particle suddenly immersed in a hot oxidizing ambient. Under appropriate conditions which are established by the analysis, the history of the particle is shown to consist principally of a heat-up period during which no significant chemical reaction takes place followed by a period involving diffusion-limited mass loss and terminating in complete particle consumption. Between these two extended periods brief ignition and post-ignition periods are described. The final demise of the particle occurs in a complex extinction period during which all the quantities describing the particle behavior undergo large variations.

8110 **Crossed-beam background-free CARS measurements in a methane diffusion flame.** Farrow, R.L.; Mitchell, R.E.; Rahn, L.A.; Mattern, P.L. (Sandia Laboratories, Livermore, CA). *AIAA Paper;* No. 81-0182, vp(1981). (CONF-810106—).

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

Coherent anti-Stokes Raman spectroscopy (CARS) obtained radial temperature profiles in a stabilized symmetric methane diffusion flame. O branch data were self-normalized to the nonresonant CARS background using the method of Oudar, Smith, and Shen (1979). Vibrational temperatures were derived from analysis of background-free nitrogen O branch spectra and rotational temperatures were obtained from Q branch measurements.

42 ENGINEERING

4201 General Engineering

8111 (BMFT-FB-T—82-113) Improvement of the efficiency of three-phase motors. Falk, K.; Schoerner, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 43p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750971.

The feasibility of optimizing the efficiency and of energy saving on asynchronous three-phase motors both with squirrel-cage or slip-ring rotor in the output range of approx. 100 to 1500 kW has been investigated with respect to three topics, i.e. optimizing of mains-supplied asynchronous machines, optimizing of inverter-supplied asynchronous machines, and the use of electronic components for speed variation. The origins of losses have been checked theoretically as well as in numerous serial tests. Special attention has been paid to the relations of the various losses to the structur's, material's and technology's parameters. The most considerable loss savings are achieved by a machine optimized regarding its electromagnetic design and the insulation technique. The operational behaviour as well as the strains even during critical dynamic phases has therefore to be taken into account. On inverter supplied machines considerable energy savings can be achieved compared to standard motors by additional measurements. Under certain circumstances even the use of a thyristor-based voltage control can result in remarkable energy savings. The biggest potential for possible energy savings is in the field of elevator technique in the speed range up to approx. 2 m/sec., and in the hoisting technique. In the long run the best saving results can be expected by using inverters, especially in the field of centrifuges, pumps and ventilators.

8112 Method of automatically welding with a non-consumable electrode. Kiefer, J.H. (to Department Of Energy). US Patent 4,350,869. 21 Sep 1982. Filed date 6 Aug 1980. vp.

PAT-APPL-175604.

A method for maintaining a constant arc gap between the electrode and the weld puddle by controlling the addition of filler wire based on the arc voltage.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 6849, 6856, 6883, 6884, 6933, 7000, 7008, 7065, 7066, 7283, 7490, 7839, 7907, 7922, 8159

8113 (BMFT-FB-T—82-071) Refrigeration system of superconducting generators for large power plants. Glatthaar, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750696.

The refrigeration system for the generator has been designed in cooperation with the manufacturer of generators. The requirements for the refrigerator have been fixed. The basic engineering, including the specifications of machines and apparatus, and a reliability study with consequences for the engineering have been worked out. According to the selected cooling system liquid helium flows with a pressure of 1.2 bars from a storage dewar, which has a volume of 5 m^3, to the rotor of the superconducting generator. Gaseous helium with ambient condition leaves the generator and is fed to the refigerator for reliquefaction. A quantity of 5 g/s of liquid helium is required for a generator with a capacity of 1000 MVA.

8114 (BMFT-FB-T—82-121) Measurements on full-face tunneling machines. Wehrmann, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1982. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750996.

1. Present status of research work: The successful preliminary lab tests on the data logging and transmission unit as developed by Bergbau-Forschung GmbH and designed to collect important equipment parameters needed to improve the full-facers in service, were not able to stand the rough underground conditions. 2. Justification and objectives of the research work: The objective of the work was to economically use the advantages of a concept of mechanized roadhead drivage system for a wide application range. The difficulties emerged could be identified only by systematic investigation; it was impossible to adequately cope with the disturbances with the technical means then available. 3. Method: Systematic logging of the entire drilling cycle, analysis of the problem points according to the work program. 4. Results: It was for the first time possible to log load distributions at the rotating drilling head of selected disc cutter tools during fully automated underground roadheading operations of a 6.0 m diameter full-facer. Weak points were identified. The data transmission and evaluation system needs further improvement to enable faster and more accurate instructions leading to an optimization of drivage operations. 5. Conclusions/possible applications: The process enables to transmit, store, record, and evaluate all the important equipment parameters. It will be possible to develop an early warning- and monitoring system which can supply correct information on both the condition at the heading as well as on the wear condition of the disc cutters. A prerequisite for such development are precise preliminary experiments using appropriate measuring transducers.

8115 (BMFT-FB-T—82-136) Regenerator consisting of a matrix of polycristalline whiskers of iron. Eder, F.X.; Appel, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1982. 82p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82751003.

The basic properties of thermal regenerators consisting of polycristalline whiskers of iron, i.e. their thermal conductivity, pressure drop, heat transfer and efficiency at temperatures between 80 and 300 K have been measured and extended to packings of wire mesh screens and microspheres consisting of bronze or stainless steel. For these structures and materials the above physical properties have been calculated theoretically and related to the experimental values. As transport gas helium, argon and dry nitrogen have been applied at pressures up to 20 bars. These experimental and theoretical studies result in a set of formula for calculating pressure drop, heat capacity, and heat transfer at a given thermal regenerator in dependence of the mass flow. The efficiency of various regenerators has been measured by a newly developed method and has been practically proved by the means of a helium regenerative expansion engine. The more general application of regenerators consisting of iron whiskers may be limited by their relative high pressure drop at low pressures.

8116 (IKE—5-215) Investigations of the long-time operation of heat pipes. Muenzel, W.D. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Aug 1981. 117p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750676.

For two typical applications concerning two different technical fields especially suitable for utilization of heat pipes, i.e. spacecraft temperature control and waste heat recovery from industrial processes, some potential working fluid/container material combinations are compiled covering the respective temperature ranges. They are subjected to compatibility tests under heat pipe operating conditions. During these tests the axial temperature distribution along each of the heat pipes is monitored periodically. From a change in temperature differences versus time at constant test conditions any long-term materials incompatibility may be detected. Rising temperatures in the evaporator section due to an increase of the radial thermal resistance most probably result from deposits of solid corrosion products, whereas an increasing temperature drop at the end of the condenser section is indicating generation of gaseous

corrosion products. Based on experimetal results, which are additionally supported by chemical and metallographical analyses, various suitable materials combinations for heat pipes are recommended together with respective cleaning and filling procedures. Special attention is given to the water/austenitic stainless steel combination which are advantageous for most applications for the operating temperature range from 50 upto 320°C concerning the thermal stability and favorable heat transfer properties as well as the mechanical strength of the container material. Possible solutions are discussed to reduce substantially the susceptibility to hydrogen generation of this materials combination under heat pipe operating conditions.

8117 **(KFK-PDV—212) Development of a controller station with failure tolerance.** Kronawitter, G.; Neudorfer, E.; Sendler, W.; Freyberger, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Prozesslenkung mit DV-Anlagen). Dec 1981. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE83900603.

Portions of document are illegible.

To increase reliability of microcomputer-based controller stations an efficient and an economic use of redundancy is of great importance. In modern instrumentation systems some principles are implemented but there is no generally fitting concept. In this report the fundamental kinds of redundancy to tolerate failures of hardware components are discussed. A structure of a multi-microcomputer-based controller station is given that allows one to project the failure-tolerance and reliability. The station may be either used as a component of a heirarchical structured, decentralized control system or as a stand-alone controller station without any loss of reliability. The reasons for the structure of the station and for the strategy of reconfiguration are given in detail based on theory of reliability. Finally some typical experiments show how the controller station acts together with a simulated technical process in case of reconfiguration.

8118 **(KFK-PDV—214) Development of a flexible, machine-integrated handling system for the automation of handling functions in controlled lathes.** Spur, G.; Furgac, I.; Popken, W.; Weisser, W.; Goehren, H.; Jinike, W.; Armbruster, N.; Kuska, J.; Rall, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Prozesslenkung mit DV-Anlagen). Dec 1981. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83900657.

The aim of this project was the development of a flexible, machine-integrated handling system for the automation of handling functions in NC controlled lathes. Elements of special purpose handling devices and flexible systems were analyzed. As a base for draft and design a requirement list was worked out. The developed machine-integrated handling system consists of the subsystems workpiece-, tool-, gauge- and clamping-jaw-handling. The part-handling device, as overhead robot, is provided with a double gripper. The tool- and gauge-handling is performed by the tools changing device. The jaw changing device was also newly developed. The system permits a simultaneous process of various handling jobs.

8119 **(LPC—81-12) Equipment calibration with a microprocessor connected to a time-sharing system.** Fontaine, G.; Guglielmi, L.; Jaeger, J.J.; Szafran, S. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1981. 12p. (CONF-810539—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82703400.

From Conference on the application of microprocessors to high energy physics experiments; Geneva, Switzerland (4 May 1981).

In H.E.P., it is common practice to test and calibrate equipment at different stages (design, construction checks, setting up and running periods) with a dedicated mini or micro-computer (such as CERN CAVIAR). An alternative solution has been developed in which such tasks are split between a microprocessor (Motorola 6800), and a host computer; this allows an easy and cheap multiplication, of independant testing set-ups. The local processor is limited to CAMAC data acquisition, histogramming and simple processing, but its computing power is enhanced by a connection to a host time-sharing system via a NUMM multiplexor described in a separate paper. It is thus possible to perform sophisticated computations (fits etc...) and to use the host disk space to store calibration results for later use. In spite of the use of assembly langage, a software structure has been devised to ease the constitution of an application program. This is achieved by the interplay of three levels of facilities: macro-instructions, library of subroutines, and Patchy controlled pieces of programs. A comprehensive collection of these is kept in the form of PAM file on the host computer. This system has been used to test calorimeter modules for the UA 1 experiment.

8120 **(ORNL/TM—8394) Maximum allowable resistive zone in a metastable superconductor.** Dresner, L. (Oak Ridge National Lab., TN (USA)). Oct 1982. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01. Order Number DE83002585.

If a metastable superconductor (i.e., not cryostable) has a small resistive zone (due, e.g., to a manufacturing defect), it may quench spontaneously at high transport current. This paper answers the related questions (1) how large is the maximum allowable resistive zone and (2) what is the effect on stability of a zone smaller than the maximum allowable one?

8121 **Passive ice freezing-releasing heat pipe.** Gorski, A.J.; Schertz, W.W. (to Department Of Energy). US Patent 4,355,522. 26 Oct 1982. Filed date 29 Sep 1980. vp.

PAT-APPL-191611.

A heat pipe device has been developed which permits completely passive ice formation and periodic release of ice without requiring the ambient temperature to rise above the melting point of water. This passive design enables the maximum amount of cooling capacity to be stored in the tank.

8122 **Radioactive materials shipping cask anticontamination enclosure.** Belmonte, M.S.; Davis, J.H.; Williams, D.A. (to Department Of Energy). US Patent 4,353,391. 12 Oct 1982. Filed date 18 Aug 1981. vp.

PAT-APPL-293911.

An anticontamination device for use in storing shipping casks for radioactive materials comprising a seal plate assembly; a double-layer plastic bag; and a water management system or means for water management.

8123 **Heat pump/refrigerator using liquid working fluid.** Allen, P.C.; Knight, W.R.; Paulson, D.N.; Warkentin, P.A.; Wheatley, J.C. (to Department Of Energy). US Patent 4,353,218. 12 Oct 1982. Filed date 28 May 1980. vp.

PAT-APPL-154173.

A heat transfer device is described that can be operated as a heat pump or refrigerator, which utilizes a working fluid that is continuously in a liquid state and which has a high temperature coefficient of expansion near room temperature, to provide a compact and high efficiency heat transfer device for relatively small temperature differences as are encountered in heating or cooling rooms or the like. The heat transfer device includes a pair of heat exchangers that may be coupled respectively to the outdoor and indoor environments, a regenerator connecting the two heat exchangers, a displacer that can move the liquid working fluid through the heat exchangers via the regenerator, and a means for alternately increasing and decreasing the pressure of the working fluid. The liquid working fluid enables efficient heat transfer in a compact unit, and leads to an explosion-proof smooth and quiet machine characteristic of hydraulics. The device enables efficient heat transfer as the indoor-outdoor temperature difference approaches zero, and enables simple conversion from heat pumping to refrigeration as by merely reversing the direction of a motor that powers the device.

8124 **Critical experiments with arrays of three-litre bottles filled with Pu(2.8)(NO3)4.** Ourst, B.M.; Clayton, E.D.; Smith, J.H. (Battelle-Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352). *Transactions of the American Nuclear Society;* **41**: 356-358(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

8125 **Roundness calibration standard.** Burrus, B.M. (to Dept. of Energy). US Patent Application 343,804. 29 Jan 1982. 9p. Contract W-7405-ENG-26.

A roundness calibration standard is provided with a first arc constituting the major portion of a circle and a second arc lying between the remainder of the circle and the chord extending between the ends of said first arc.

8126 **Chemical heat pumps (reversible chemical reactions at medium/high temperature).** van Velzen, D. (Commission of the European Communities, Ispra, Italy). pp 93-113 of Thermal energy storage. Beghi, G. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1982).

Reversible chemical reactions can be used for the storage of thermal energy, as well as for upgrading of this energy by means of chemical heat pumps and heat transformers. A survey of the technological possibilities, the work in course and an outlook for the future is given. The use of catalytic homogenous reactions at medium/high temperature generally involve low round-trip thermal efficiencies. The development of chemical heat pumps and heat transformers may offer a solution to this problem. The technological development of such devices is in a very early stage and there exists a considerable potential for interesting innovations.

8127 **Unique potential for transportation of woodchips by pipeline.** Stripling, T.E.; Sullivan, J.D. (Brown & Root, Inc., Houston, TX). pp 243-254 of Sixth international technical conference on slurry transportation. Proceedings. Washington, DC; Slurry Transport Association (1981).

From 6. international technical conference on slurry transportation; Las Vegas, NV, USA (24 Mar 1981).

The project described in this paper has several characteristics that make a slurry pipeline transportation system more economical than a truck-road scheme. The feasibility study shows that the unit transport rate (dollars/cord) for the slurry pipeline is only about 60 to 65% that of a truck-road system.

4203 Lasers

REFER ALSO TO CITATION(S) 6992, 7896, 8879

8128 **(MPQ—45) Generation of tunable infrared radiation by stimulated electronic hyper-Raman-effect in strontium vapour.** Reif, J. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). May 1981. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750434.

Tunable infrared radiation in the wavelength range of 16 um was generated by stimulated electronic hyper-RAMAN scattering in atomic strontium vapour using a pulsed dye laser. A nearby two-photon resonance was used to enhance the conversion efficiency. The actual infrared output was, however, much less than estimated from perturbational calculations. In addition, the observed dependence of the STOKES energy on the power of the dye laser differed drastically from the expectation of perturbation theory. There is, however, quite good agreement between experiment and a non-perturbational description of the process, which had been stimulated by the present work. According to this theory, the observed saturation in the conversion process as well as the shape of the STOKES pulses is due to a significant depletion of the atomic ground-state population by the pumping light. Therefore, only a small intensity of the generated infrared radiation has been observed. The spectral properties of the generated infrared light were investigated. The bandwidth of the STOKES radiation depends linearly on the width of the pump laser and is always smaller than that. Moreover it is influenced by the strontium vapour pressure and, very strongly, by the intensities of pump and generated light.

8129 **Electron-beam magnetic switch for a plurality of free-electron lasers.** Schlitt, L.G. (to Dept. of Energy). US Patent Application 342,982. 26 Jan 1982. 13p. Contract W-7405-ENG-48.

Apparatus for forming and utilizing a sequence of electron beam segments, each of the same temporal length (substantially 15 nsec), with consecutive beams being separated by a constant time interval of the order of 3 nsec is described. The beam sequence is used for simultaneous inputs to a plurality of wiggler magnet systems that also accept the laser beams to be amplified by interaction with the co-propagating electron beams. The electron beams are arranged substantially in a circle to allow proper distribution of and simultaneous switching out of the beam segments to their respective wiggler magnets.

8130 **Single mode nitrogen pumped dye laser.** Iles, M.K.; D'Silva, A.P.; Fassel, V.A. (Ames Lab., IA). *Optics Communications;* 35: No. 1, 133-136(Oct 1980). Contract W-7405-ENG-82.

A N_2-laser pumped, tunable dye laser has been operated in a stable single longitudinal cavity mode without the use of etalons, polarized pump sources or intracavity polarising elements. The all-reflective cavity employs a grazing incidence beam expansion grating and a Littrow tuning grating. The time averaged linewidth, of 0.02 cm^{-1} (630 MHz) for 5 x 10^{-3} M R6G dye was observed to be the same as the single shot linewidth, with an efficiency of 0.5%. A dye concentration of 10^{-2} M R6G increased the single mode linewidth to the value predicted by a single pass model of the cavity and increased the efficiency to 1.5%. A Littrow grating can be used to replace the feedback mirror and enhance the output signal to noise ratio.

8131 **Excimer lasers.** Ewing, J.J. (California, University, Livermore, CA). pp 135, 137-197 of Laser handbook. Vol. 3. Stitch, M.L. Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

The general class of lasers operating in the ultraviolet and vacuum ultraviolet spectral regions commonly called excimer lasers is reviewed here. The general characteristics of these laser media are discussed along with the technology required to excite these lasers. The spectroscopy of this class of molecular species is reviewed. The spectral characteristics of absorbers generated in the media in the course of generating laser gain are discussed. Nonsaturating losses in these media limit the efficiency and scalability of these devices. The kinetic mechanisms for producing and quenching these excited molecular species are reviewed and tabulations of pertinent kinetic data are given. The technologies associated with electrically exciting these species are discussed.

8132 **Technology of bandwidth-limited ultrashort pulse generation.** Lowdermilk, W.H. (California, University, Livermore, CA). pp 361-420 of Laser handbook. Vol. 3. Stitch, M.L. Amsterdam, Netherlands; North-Holland Publishing Co. (1979).

The present paper deals with longitudinal mode-locking solid-state Nd lasers and dye lasers, which produce pulses with durations less than 100 psec. The mathematical description of an optical pulse is summarized to clearly define the meaning of a 'bandwidth-limited' pulse. The formation of an ultrashort pulse by longitudinal mode locking is formally presented, along with a brief review of ultrasonic pulse measurement techniques. Passive mode locking is discussed in some detail with particular reference to the formation process of ultrashort pulses. It is shown that there is a basic difference between the pulse formation processes in solid-state and dye lasers, which is associated with the excited-state lifetime of the active transition, and which requires separate models.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 7620, 8057, 8058

8133 **(IKE—2-54) Heat transfer at hot spheres in the saturated and subcooled film boiling regime.** Kammerer, E.; Buerger, M.; Schwalbe, W. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Jun 1981. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750682.

For the description of heat transfer at hot spheres in the saturated and subcooled film boiling regime two models from the literature are used and adequately modified. This means mainly the consideration of the effect of subcooling which is added in the

models. This leads to ordinary differential equation systems which can not be integrated analytically but have to be solved numerically. The results of the calculations performed are discussed in detail and the comparison with experimental data gives some insight in the discrepancies between theory and experiment. However more experimental investigations seem to be necessary. This should be done under the special requirement to verify the considered heat transfer models. Furthermore a correlation to calculate the heat transfer in film boiling is presented. This correlation on the one side describes theoretically the heat transfer phenomena but has a second version also been fitted by experimental data.

8134 **(IKE—2-56) Theoretical analysis of thermal molten metal-water reactions.** Schwalbe, W. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). 22 Feb 1982. 170p. (In German). B. Order Number DE82751049.

V 08/MF A01.

In experiments with greater masses (kg-scale) two extreme cases had been oberved during the course of reaction when hot melt reacted with a vaporizable cooler liquid. Relatively mild hot interactions with slow pressure build-up and small pressure peak in the reaction volume often occurred but there were also some very violent reactions (steam explosions) where a remarkable portion of thermal energy had been transformed into mechanical energy with high pressure peaks. For the two types of reactions overall models for water as a coolant are developed here. Based on calculations and on comparisons with corresponding experiments it is shown that a relatively mild course of reaction can be explained by a fragmentation of the melt under following violent evaporation of the cooling medium. Pressures only with small reaction volumes up to the MPa range can be found in these reactions. The calculations, for example of Bird and Millington, showed a pressure maximum of 1 MPa after 170 ms of the start of the reaction; this agrees very well with the result of the experiment of 1.08 MPa.

8135 **(KFK—3138) Dependence of dryout heat flux on particle diameter for volume- and bottom-heated debris beds.** Barleon, L.; Werle, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Nov 1981. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750435.

The dependance of the dryout heat flux on the particle diameter has been investigated experimentally for volume- and bottom-heating in the particle diameter range 1 to 16 mm for Freon-113 and water. The experimental data for volume-heating are in agreement with theoretical models assuming turbulent flow, whereas the laminar models overpredict the dryout heat flux in this particle diameter range heavily. For bottom-heating the dryout heat flux shows the same particle diameter dependance as for volume-heating as long as the beds are in packed state, but the absolute values are about a factor of two lower. Beds may dryout at different heat fluxes depending on the state they assume.

8136 **(KFK—3223) Enhancement of heat transfer between two horizontal liquid layers by gas injection at the bottom.** Werle, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Oct 1981. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750354.

In connection with investigations concerning the cone melt-concrete interaction the enhancement of heat transfer between two horizontal liquid layers by gas injection has been studied using two systems - oil over water and oil over Wood metal - with very different density ratios. For the largest gas injection rate (superficial gas velocity 0.63 cm/s) the heat transfer coefficient is increased by nearly a factor 400 for oil over water and by about a factor of ten for oil over Wood metal. In the core melt-concrete interaction the superficial gas velocities might be even higher, therefore the gas-induced enhancement of interfacial heat transfer should be taken into account.

8137 **(KFK—3271) Numerical simulations of the laminar-turbulent transition process in plane Poiseuille flow.** Kleiser, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Apr 1982. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750980.

Laminar-turbulent transition in plane Poiseuille flow is simulated by numerical integration of the time-dependent three-dimensional Navier-Stokes equations for incompressible flow. The mathematical model of a spatially periodic, timewise developing flow in a moving frame of reference is used to match vibrating-ribbon experiments of Nishioka et al. The numerical discretisation is based on a spectral method with Fourier and Chebyshev polynomial expansions in space and second order finite differences in time. The pressure is calculated using a new method which enforces incompressibility and boundary conditions exactly. This is achieved by deriving the correct boundary conditions for the pressure Poisson equation. The numerical results obtained for two-dimensional finite amplitude disturbances are consistent with nonlinear stability theory. The time-periodic secondary flow is attained by the time-dependent calculation with reasonable accuracy after a long quasi-steady state. No sign of two-dimensional instability, but strong three-dimensional instability as well of the periodic secondary flow as of the quasi-steady state is found. This secondary three-dimensional instability is shown to be responsible for transition. It is shown that the three-dimensional simulations presented here reproduce the experimentally observed transition process up to the spike stage. Detailed comparisons with measurements of mean velocity, rms-values of fluctuation and instantaneous velocity distribution reveal very satisfactory agreement. The formation of peak-valley structure, longitudinal vortices, local high-shear layers and distinct spike-type signals is shown. In addition, the three-dimensional flow field structure before breakdown is investigated. An array of horseshoe vortices similar to those inferred from boundary layer flow visualization experiments is found. Spike signals are produced by local accumulations of low-speed fluid in the downstream loops of these vortices.

8138 **(KFK—3324) Experimental investigations on the fluid flow through an asymmetric rod bundle (W/D = 1.026).** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). May 1982. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750991.

Measurements of the distributions of the mean velocity, the wall shear stresses and the turbulence were performed in a wall subchannel of a rod bundle of four parallel rods arranged asymmetrically in a rectangular channel (P/D = 1.07, W/D = 1.026). The Reynolds number of this investigation was $Re = 5.46 \times 10^4$. The experimental results show that the momentum transport is highly anisotropic especially in the gaps of the rod bundle. Influences of secondary flow cannot be detected in the distribution of the time-mean velocity, however, such influences are found in the distributions of the turbulence intensities and the kinetic energy of turbulence. The comparison between experimental wall shear stress distributions and those calculated with the VELASCO-code shows discrepancies especially in the gap between the rod and channel walls.

8139 **(NP—2906278) Self-induced pulsating liquid flow in a hydraulic system.** Meier, G.E.A.; Szumowski, A.P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Dec 1980. 50p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82906278.

Pulsating liquid flow of large amplitudes can appear in hydraulic lines as a result of the interaction between flow and valves. In this paper such a flow in a system containing a tank, a tube and a valve, which has an elastically supported plate, is investigated. The functions of the flow properties versus some non-dimensional parameters have been found. These parameters depend upon supply pressure, inertia of the liquid and of the valve, as well as the elasticity of the plate support and the dimensions of the system. The occurrence of cavitation zones in the liquid flow has been taken into

account. Theoretical results have been compared with experimental ones.

8140 **(SAND—79-1622) MARIAH: a finite-element computer program for incompressible porous flow problems: theoretical background.** Gartling, D.K.; Hickox, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1982. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01. Order Number DE83002628.

The theoretical background for the finite element computer program MARIAH is presented. The MARIAH code is designed for the analysis of incompressible fluid flow and heat transfer in saturated porous media. A description of the fluid/thermal boundary value problem treated by the program is presented and the finite element method and associated numerical methods used in MARIAH are discussed. Instructions for use of the program are documented in the Sandia National Laboratories report, SAND79-1623

8141 **(SAND—82-8865) Internal structure of a premixed turbulent flame.** Rajan, S.; Smith, J.R.; Rambach, G.D. (Southern Illinois Univ., Carbondale (USA); Sandia National Labs., Albuquerque, NM (USA)). Oct 1982. Contract AC04-76DP00789. 29p. (CONF-821035—7). NTIS, PC A03/MF A01. Order Number DE83001948.

From Combustion Insitute symposium on western states section; Livermore, CA, USA (11 Oct 1982).

A pulsed laser and a multielement detector have been used to make instantaneous Rayleigh profiles along a line through a turbulent flame front thus eliminating the effects of flame front motion. The flame front in a premixed turbulent flame moves randomly about a mean position, giving rise to the visually observed flame brush or time-averaged flame thickness which is larger than the instantaneous thickness of the reaction zone. The physical characteristics and statistical properties of such turbulent flames reported previously were deduced from the time histories of Rayleigh scattered laser light at one or two points within the reaction zone. The study was conducted on a premixed propane-air flame stabilized on a rod at the exit plane of a square burner. Turbulence-producing screens below the burner exit controlled turbulent length scales while intensity was controlled with inlet mixture velocity. Turbulence properties of the cold reactants were determined by hot-wire anemometry. Mean and fluctuating velocity in the unburnt and burnt gases were measured using laser Doppler velocimetry. At the low level of turbulence studied, the instantaneous flame front thickness was found to be only slightly greater than the laminar flame thickness, and the magnitude of the density fluctuations only slightly greater than the cold flow turbulence intensity. Mean and rms values of density and velocity; density and velocity probability density functions; spatial density correlations; and comparison of data with the Bray-Moss-Libby model are presented.

8142 **Ultrasonic liquid film thickness measurements.** Starkovich, V.S.; Bird, P.F.; Dallman, J.C.; Strong, R.D. (LASL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **35**: 640-642(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

4205 Materials Testing

REFER ALSO TO CITATION(S) 7583, 8207

8143 **(GKSS—80/E/58) Methods for investigating crack propagation.** Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1980. 13p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750687.

The present paper presents a brief introduction in the methods for the investigation of crack propagation. Included are optical measurements, compliance method, potential method, and microscopic methods.

8144 **(GKSS—81/E/59) Test techniques for fracture mechanics testing.** Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1980. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750688.

Test methods for fracture mechanics tests are described. Two groups of techniques are distinguished: Those for measurement of stable crack growth and those for determination of the loading parameters.

8145 **Phase-multiplication holography.** Collins, H.D.; Prince, J.M.; Davis, T.J. (to Dept. of Energy). US Patent Application 342,431. 25 Jan 1982. 33p. Contract AC06-76RL01830.

This disclosure relates generally to nondestructive testing for identifying structural characteristics of an object by scanned holographic techniques using a known source of radiation, such as electromagnetic or acoustical radiation. It is an object of this invention to provide an apparatus and method for synthetic aperture expansion in holographic imaging applications to construct fringe patterns capable of holographic reproduction where aperture restrictions in nondestructive testing applications would conventionally make such imaging techniques impossible. The apparatus and method result in the production of a sharply defined frontal image of structural characteristics which could not otherwise be imaged because they occur either near the surface of the object or are confined by geometry restricting aperture dimensions available for scanning purposes. The depth of the structural characteristic below the surface of the object can also be determined by the reconstruction parameters which produce the sharpest focus. Lateral resolution is established by simulated reduction in the radiation wavelength and may easily be an order of magnitude less than the electromagnetic wavelength in the material or 2 times the standard depth of penetration. Since the phase multiplication technique is performed on the detected data, the penetration depth available due to the longer wavelength signals applied to the test object remains unchanged. The phase multiplication technique can also be applied to low frequency acoustic holography, resulting in a test which combines excellent penetration of difficult materials with high resolution images.

8146 **Volumetric inspection of moderately thick austenitic stainless steels by multifrequency eddy currents.** Scott, G.W.; Dodd, C.V. (Oak Ridge National Laboratory, Oak Ridge, TN). *Journal of Nondestructive Evaluation;* **2**: 23-33(Mar 1981). Contract W-7405-ENG-26.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 7608

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 8006

8147 **(HMI-B—368) Characterization of buried layers after counterdoping ion implantation in silicon with regard to the buried channel charge-coupled device.** Bach, H.G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik). Dec 1981. 268p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE83900604.

Thesis. Submitted to the Technische Univ., Berlin, Germany. Portions of document are illegible.

Novel electric measurement techniques for characterization of ion implanted pn-junction structures are reported. These pn-junctions are commonly used in Buried Channel Charge-Coupled Devices and Depletion-Mode-Field effect transistors. Admittance measurements on MOS varactors in the frequency range of 100 Hz to 10 MHz are evaluated to determine the sheet resistance of the buried layer, the pn-junction capacitance and the pn-junction conductance. Measurements of real and imaginary parts of the crosstalk voltage are based on currents spreading far into the lateral channel in the frequency range of 30 Hz to 200 kHz. This technique is

shown to be better suited to determine the pn-conductance compared to admittance measurements. Measured parameters are plotted against the implanted ion dose. For doping profiling of the buried layer the MOS-rf-capacitance is corrected for the serial lateral distributed pn-admittance. Bias depending sheet resistance modulation underneath the gateelectrode and channel pinch off caused by the penetrating space charge region are included in the correction model which is applied to equilibrium and non-equilibrium C-V data. The obtained doping profiles agree well with those from implantations into test samples of equal conductivity.

8148 **(ORNL/SUB—79/21453/11) 60-GHz gyrotron development program. Quarterly report No. 11, January-March 1982.** Shively, J.F.; Craig, L.J.; Evans, S.J.; Felch, K.L.; Fox, L.J.; Hu, G.; Jory, H.R.; Spang, S.T. (Varian Associates, Palo Alto, CA (USA). Palo Alto Microwave Tube Div.). 1982. Contract W-7405-ENG-26. 55p. NTIS, PC A04/MF A01. Order Number DE83000431.

Portions of document are illegible.

The objective of this program is to develop a microwave oscillator capable of producing 200 kW of CW power at 60 GHz. Tests on two experimental tubes, X-3R and X-4, were completed during the quarter. X-3R, which included design modifications to the beam tunnel and cavity coupling, produced 200 kW of peak rf output power at 100 ms pulse duration. The tube proved to be easier to operate than previous experimental tubes because of the modifications. X-4, which used an older rf circuit design, but in a CW configuration, produced 71.5 kW CW.

8149 **(UCRL—15509) Pulse response profiles Model 776B. High performance signal conditioning unit.** (Ectron Corp., San Diego, CA (USA)). 24 Sep 1982. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01. Order Number DE83002282.

Since the advent of underground nuclear testing at the Nevada Test Site (NTS) one of the more difficult instrumentation problems has been the amplification of low level analog signals that follow the system generated electromagnetic pulse (SGEMP). After a number of years of dealing with these instrumentation problems of NTS, a specification was developed for a High Performance Signal Conditioning Unit (HPSCU) that represented a culmination of the requirements for a transducer conditioner/amplifier at that time. Based on this specification and incorporating an unusual Ectron proprietary design, the Model 776 was developed in 1976. The results of testing an improved version of this unit are discussed. Five Ectron Model 776B High Performance Signal Conditioning Units were tested under a variety of pulse overload conditions. The 5 amplifiers were subjected to 6 pulse overload tests involving normal mode (NM), Common Mode (CM) and bridge circuit conditions. The bridge tests include a combination of NM and CM pulses plus use of the excitation supply to approximate field conditions. This report analyses these data and, depending on application conditions, indicates expected recovery times. In addition, recommendations on ways to use this instrument to minimize recovery are given. Assuming high NM and Cm pulse levels and the use of a circuit configuration similar to that used in tests 5 and 6, recovery of the Model 776B HPSCU is affected by the following factors listed in order of importance: NM pulse width and amplitude; not using the 776B guard; lack of guard shielding of the input signal system; high amplifier step gain; and CM pulse width and amplitude.

8150 **(UCRL—52434-Vol.10) Development of alternate silicone potting compounds. Vol. 10. Analysis and characterization of silicone potting compounds and related materials.** Cady, W.E. (Lawrence Livermore National Lab., CA (USA)). 11 Sep 1981. Contract W-7405-ENG-48. 144p. NTIS, PC A07/MF A01. Order Number DE83002654.

LLNL, and Pantex have thoroughly analyzed and characterized (1) the discontinued DC93 series of silicone potting compounds, (2) the commercial materials used to develop alternate compounds, and (3) representative alternate silicone potting compounds which we have developed. We evaluated the individual components, the activated blends of components and cured compounds. We measured physical and chemical properties, determined elemental compositions, measured trace impurities, and measured molecular weight by high-performance size-exclusion chromatography. We applied the techniques of thermal gravimetric analysis, thermal mechanical analysis, differential scanning calorimetry, and Rheometrics mechanical spectrometer analysis to characterize all of these materials. We evaluated the effect of shelf aging of the commercial starting materials and of the alternate components on the properties of the components and the activated and cured compounds. Results are collected in this report. 105 tables, 31 figures.

8151 **(ZfK—456) Step motors.** Hoehne, V. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1981. 11p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750956.

The principle design and the operation of step motors and the modes of controlling them are described. A short review of the step motors and the control and driver circuits available today in the Central Institute for Nuclear Research is given.

4209 Waste Processing Plants And Equipment

8152 **(BMFT-FB-T—81-217) Peripheral compressor for sewage clarification plants.** Bender, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1981. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750353.

For the air-injection in clarification plants today mostly Roots-compressors are used, which have to be installed in separate engine rooms to reduce the noise emission and to enable the maintenance work. With the application of peripheral compressors this expense can be reduced, because these maintenance-free compressors are able to work under the water surface. So the sound-absorbing effect of the water can be used and there is no need for engine rooms and surface pipes. In the present development stage, peripheral compressors have a lower efficiency than the Roots compressors. The aim of this research project was to increase the efficiency of the peripheral compressors to become cost effective for the whole operation period, as a further noise reduction. By means of the optimization of the flow in the blading and the air inlet the performance and the efficiency of this compressor could be doubled in comparison with standard peripheral compressors. By improving the silencers the noise emission could be significantly reduced. With these advanced compressors there are available efficient instruments for the use in sewage clarification plants.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 6727, 6742, 6911, 6912, 6921, 7250, 8244

8153 **(BMFT-FB-T—81-222) Promotion of utilizing primary energy and reduction of emission with grate-equipped heat generators fired completely automatic with solid fuels.** Nickel, E.; Hoefeld, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1981. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750355.

Two boiler systems for the combustion of anthracite of grain sizes 'Nuss 4', 'Nuss 5' and 'Nuss 5 spezial' as well as crushed coke have been developed and improved, differing in their output range and in the applied grate types. This development has led to the practical applicability of both systems. Further examinations are being made with the aim of operating the generators in accordance with TDR 604 (operation without permanent supervision). Both boiler systems will allow the substitution of fuel oil by coal or coke and will offer nearly adequate maintenance facilities and boiler efficiency as with fuel oil.

8154 **(DOE/FC/10120—T7) Analysis and characterization of atmospheric fluidized-bed-combustion agglomerates. Final report.** Brekke, D.W.; Karner, F.R. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). Jun 1982. Contract AB18-80FC10120. 114p. NTIS, PC A06/MF A01. Order Number DE82020374.

The combustion of high-sodium low-rank coal in an Atmospheric Fluidized Bed Combustor (AFBC) can produce agglomeration of varying severity. Agglomerates and bed materials produced by a 0.2 m^2 AFBC were studied by polarized light microscopy, scanning electron microscopy, and electron microprobe analysis of thin sections. Bulk samples were studied using x-ray diffraction and x-ray fluorescence techniques. A physio-chemical or geochemical approach was used to characterize the materials and to postulate a mechanism of formation of the agglomerates. Quartz bed materials typically have nodular ash coatings with a matrix of finer sulfate ash richer in calcium and sulfur. Quartz bed agglomerates have additional calcium-rich sulfur-poor glass binding the grains together. Limestone bed materials typically have nodular ash coatings and have concentric alteration zones of calcium-rich areas with additional sulfur, iron, and sodium. Limestone agglomerates have additional sulfation and masses of coarse $CaSO_4$ crystals. Agglomerate formation in quartz bed materials follows a 4-stage process: an initial ash coating of about 50 microns thickness; thickened nodular coatings and initial sulfation; initial agglomeration by a cement of sulfated aluminosilicate ash; and bonding by recrystallized sulfated ash which has partly melted and solidified. Agglomerate formation in limestone bed materials follows a 3-stage process: initial bed grain alteration or calcining and sulfation producing concentric zones; thickened nodular ash coatings and continued sulfation; and agglomeration and growth of large $CaSO_4$ crystals. The agglomeration process is believed to be dependent upon temperature excursions caused by ash buildup in the bed with accompanying interaction between ash and bed material. Sodium appears to play a critical but presently largely unknown, role in the reactions producing agglomerates.

8155 **(DOE/METC—82-59-Vol.2) Fluidized-bed combustion reports: bibliography.** Byam, J.W. Jr. (ed.). (USDOE Morgantown Energy Technology Center, WV). Oct 1982. 250p. NTIS, PC A11/MF A01. Order Number DE83002925.

Portions of document are illegible. Printed copy available until stock is exhausted.

An author index, report number index, and subject index to the bibliography of fluidized-bed combustion reports are presented. (LCL)

8156 **Thermal cleaning of temporary explosive waste air.** Huening, W. Bonn, Germany, F.R.; Bundesministerium fuer Forschung und Technologies (Dec 1981). 23p. (In German). (BMFT-FB-HA—81-015).

Because of high explosion hazards resulting from the combustion of air streams containing wastes with large amounts of burnable substances, a research program was founded for the purpose of accident prevention. The aim of the project was to develop a process for safe and dangerless thermal cleaning of polluted air with flow rate and concentration of hydrocarbons varying in wide range with respect to the economical expense. In this purpose a flashback-proof burner was developed and by an improved burning technique the cleaning of polluted air was possible even with contents and flow varying over wide limits. This was supplemented by a further development of safety and controll equipment. A test under conditions finished the investigations showing the good cooperation of all process elements. The 'Tarex'-Process, resulting from this development, solves the problems of burning technique and safety in combustion plants for the treatment of explodable waste air.

8157 **Process and control of chip and peat heated industrial boiler.** Koskinen, J.; Kiukaanniemi, E.; Huotari, J. Espoo, Finland; Valtion Teknillinen Tutkimuskeskus (Nov 1981). 120p. (In Finnish). (VTT-TUTK—81-43). Valtion Teknillinen Tutkimuskeskus, Espoo, Finland. Order Number DE82750332.

With the help of measured data, pressure, temperature, flow and gas analysis, the variations of process data were calculated. In this way the influence of fuel and its quality on the operations of fuel feed system, control system and thermal power generation could be estimated. The power generation in grate firing varies with the peat quality, the main causes being fluctuations of the peat moisture and the decomposition degree, which affect fuel flow on the grate. Milled peat, moisture content 45-50%, appears to be most suitable in grate firing. The low effect of pulverized firing and too high dependence on the quality of the fuel and manual control prevent the use of pulverized firing in practice as a power control device. Additionally the low capacity of the wind screening system causes limitations to the pulverized firing capacity. The compensation of fluctuations in solid fuel firing has been carried out by controlling the control fuel (waste liquor), support fuel and other boilers. This may increase costs in energy production. As the quality of fuel can be largely affected only by the choice of suitable fuel mixtures, the function of fuel unloading equipment should be improved so that the desired mixture can be achieved. The even flow of fuel can be arranged only by making fuel feed automatical, or self-correcting. Another factor, which softens the process function, is adjusting the fluctuation of the combustion intensity by automatical control of tertiary oxygen flow.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 6847, 6848, 8114, 8464, 8465

8158 **(BMFT-FB-T—81-223) Myria-wireless-communication. Pt. 1. Analysis of the practicability of a wireless information transmission system in mines by electromagnetic ELF-waves.** Scheffner, H.; Heinz, D.; Jochum, K.F. (Bundesminisierium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1981. 307p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE82750356.

Concerning the research and development program MYRIA-WIRELESS-COMMUNICATION, Part 1, a feasability study was carried out to analyse, whether there is the practicability of wireless information transmitting and receiving between surface and underground stations by means of electromagnetic ELF-waves. For this purpose primary and orientative measurements in mines together with theoretical investigations have been made. The rates of the magnetic field strenghts have been computed as a function of range with different parameters for several types of antennas. One transmitting station and two mobile receiving sets have been developed. The electromagnetic noise and the propagation of ELF-waves in underground mines have been experimentally studied and analyzed. The results of the theoretical and experimental investigations underline the practicability of a wireless information transmission system in mines using frequencies below 300 Hz. It is recommended to continue this program.

8159 **(BMFT-FB-T—82-009) Technology of mobile high-capacity large-size equipment for mining and haulage in sloping seam-like deposits.** Kulnig, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jan 1982. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750436.

Objective: Transfer of open-cast mining methods to underground mining. Adaptation and further development of earth moving and open-cast mining equipment to the more difficult conditions of underground mining for technical and economic optimization of the drilling, blasting, loading and hauling operations. Working programme: Further development and improvement of hydraulic rock drilling hammers for optimizing the drilling operations. Development of opening shots for maximizing the rounds of shots in deposits consisting of tough material. Testing of hydraulic excavators and adaptation to the confined conditions of undergrund working. Development of a flexible haulage method for underground mining in increasing depths. Testing and further development of heavy-duty trucks as the main means of transportation on ramps with an ascending slope. Improvement of operational safety and job hygiene by means of the newly developed technology. Result: The new technology developed for mobile heavy-duty large-size equipment for mining and haulage permits to work deposits of medium thickness by underground methods with costs and results being comparable to those of open-cast mining. The connection between drilling, blasting, loading and hauling is analyzed.

8160 **(BMFT-FB-T—82-087) Improved roadheading by dinting behind the face line to full section.** Seeger, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1982. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750723.

The project aimed at a roadheading advance rate which could keep pace with increased face advance, by systematic application of techniques developed in the field of roadheading, face operations, and support setting. Simultaneously, the roadway stability was to be increased for keeping roadway maintenance expenditure at a minimum. During the trials, however, unexpected swelling of the floor occured to such an extent that the special shield units and the integrated roof bolting drilling equipment could not fulfil the tasks assigned. Also the support design tailored to measure to the new technique did not withstand the high strata pressures. For operational and economic reasons therefore the project was aborted and, as before the trials, the road was headed in advance of the face.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 6811, 8156

4250 Power Cycles

8161 **Thermodynamic engines. Numerical analysis.** Illum, K. Aalborg, Denmark; Aalborg Universitaetscenter (1981). 100p. (In Danish). (NP—2750747).

A thermodynamic engine is defined as an abstract concept: an open thermodynamic system operating in cycles. It is shown that a general and consistent method for the evaluation of the effectiveness of such systems should be based on the separation of the concurrent processes into process groups, each process group being closed with respect to any other group. A general expression of thermodynamic efficiency based on the concept of energy is given. A computer program which enables the modelling and numerical analysis of any thermodynamic engine within a comprehensive class of classical engines is documented and demonstrated through examples.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 8602, 8603

8162 **(KFK—3228) Proceedings of the workshop on high intensity accelerators and compressor rings.** Kuntze, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1981. 257p. Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany, F.R.

From Workshop on high intensity accelerators and compressor rings; Karlsruhe, Germany, F.R. (25 - 26 Jun 1981).

These proceedings contain the articles presented at the named workshop. They concern developments in beam transport systems for advanced neutron sources. Separate abstracts were prepared for the articles in these proceedings.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 7907

8163 **(GSI—82-2) SIS an accelerator facility for heavy ions of high energy.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1981. 188p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82750685.

In the present project proposal SIS an accelerator facility for heavy ions on the base of two synchrotrons is described, by which atomic nuclei up to uranium can be accelerated to energies above 10 GeV/u. With the first stage called SIS 12 the heavy ion physics at intermediate energies up to 500 MeV/u can be studied. The second stage, a larger synchrotron SIS 100 with a diameter of 250 m agrees in its dimensions with the facility presented already in July 1979 in a first version of this project proposal. By that the range of relativistic heavy ion physics up to 14 GeV/u (for intermediate mass projectiles) e.g. 10 GeV/u (for uranium) shall be made accessible.

8164 (Juel-Spez—146, pp 111-112) **Cyclotron operation and improvement.** Aldea, L.; Boege, H.G.; Braeutigam, W.; Borsch, H.; Brings, R.; Fiedler, R.; Jannakos, I.; Mayer-Boericke, C.; Reich, J.; Retz, A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 8191, 8193

8165 **(DESY—82-015) Transverse beam cavity interaction. Pt. 1.** Weiland, T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750710.

The transverse interaction between a bunch of charged particles and cylindrically symmetric accelerating structures is studied in three steps. The particle motion is influenced by short range forces and long range forces. The short range forces are calculated by solving Maxwell's equations in the time domain including the presence of free moving charges passing an arbitrarily shaped structure off axis. The long range forces are dominated by resonant modes in cavities. These forces are computed in frequency domain by evaluating eigenmodes and eigenfrequencies. Since only high energy particles are considered, the particle motion, which is affected by both forces, can be studied seperately using simple models and computer simulations.

8166 **Why a second-order magnetic optical achromat works.** Carey, D.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nuclear Instruments and Methods in Physics Research;* **189**: No. 2/3, 365-367(1 Nov 1981).

A design procedure for a charged particle optical system where all second order matrix elements can be made to vanish simultaneously has been described by Brown. The symmetry of the system requires all geometric second-order matrix elements to vanish. A proof is given that all chromatic second-order matrix elements will also vanish.

8167 **LADON photon beam at Frascati.** Federici, L. (Laboratori Nazionali di Frascati, Italy); Giordano, G.; Matone, G. *Hadronic Journal;* **4**: No. 4, 1295-1305(Jun 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

We briefly report the activities of the LADON collaboration at the Frascati National Laboratories, which has developed a γ ray beam at intermediate energy using an Argon Ion Laser, and the ADONE electron storage ring.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 8198, 8199, 8224, 8484

8168 **(BONN-HE—82-2) Tagged photon beam facility at the Bonn 500 MeV synchrotron.** Arends, J.; Eyink, J.; Hartmann, H.; Hegerath, A.; Mecking, B.; Ros, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Jan 1982. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750665.

A facility for the investigation of medium energy photonuclear reactions is described. A bremsstrahlung tagging system produces a precisely known flux of monochromatic photons in the energy range between 100 and 450 MeV. Resolution and intensity of the system are given. Photoemitted particles can be detected in

various large solid angle detectors. The performance of the facility and future developments are discussed.

8169 (CERN—82-02, pp 136-146) **Resistance to ionizing radiations of materials installed at the CERN accelerators.** Schoenbacher, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Apr 1982. (In French). NTIS (US Sales Only), PC A09/MF A01.

From ATSR meeting on health physics; Geneva, Switzerland (12 Nov 1981).

All materials installed in high energy accelerators along the lines of primary and secondary beams are exposed to ionizing radiation. This can in certain cases cause a degradation of the properties of these materials and consequently affect the good function of the installation. The author has taken at CERN large number of samples of materials in order to determine their radioresistance. Generally the organic materials and the electronic components are more sensitive to ionizing radiation. The author presents the results of these studies which concern the isolations of the cables (polyethylene, polyvinyl chloride, caoutchouc ethylene propylene, etc.), the isolations for the magnets on the base of epoxy resins, as well as other thermoresistant and thermoplastic products. The author equally presents a choice of materials and components which are used at CERN and which are resistant to radiations above an integral dose of 10^7-10^8 Gy.

8170 (DESY-SR—82-05) **High flux and high resolution VUV beam line for synchrotron radiation.** Wilcke, H.; Boehmer, W.; Schwentner, N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750946.

A beam line has been optimized for high flux and high resolution in the wavelength range from 30 nm to 300 nm. Sample chambers for luminescence spectroscopy on gaseous, liquid and solid samples and for photoelectron spectroscopy have been integrated. The synchrotron radiation from the storage ring DORIS (at DESY, Hamburg) emitted into 50 mrad in horizontal and into 2.2 mrad in vertical direction is focused by a cylindrical and a plane elliptical mirror into the entrance slit of a 2m normal incidence monochromator. The light flux from the exit slit is focused by a rotational elliptic mirror onto the sample yielding a size of the light spot of 4 x 0.15 mm^2. The light flux at the sample reaches 7 x 10^{12} photons $nm^{-1}s^{-1}$ at 8 eV photon energy for a current of 100 mA in DORIS. A resolution of 0.007 nm has been obtained.

8171 (DOE/ER/10740—6) **Synchrotron topography project. Progress report, January 20, 1982-October 20, 1982.** Bilello, J.C.; Chen, H.; Hmelo, A.B.; Liu, J.M.; Birnbaum, H.K.; Herley, P.J.; Green, R.E. Jr. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering). 1982. Contract AC02-80ER10740. 24p. NTIS, PC A02/MF A01. Order Number DE83002447.

The collaborators have participated in the Synchrotron Topography Project (STP) which has designed and developed instrumentation for an x-ray topography station at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory (BNL). The two principle instruments constructed consist of a White Beam Camera (WBC) and a Multiple Crystal Camera (MCC) with high planar collimation and wide area image coverage. It is possible to perform in-situ studies in a versatile environmental chamber equipped with a miniature mechanical testing stage for both the WBC and MCC systems. Real-time video imaging plus a rapid feed cassette holder for high resolution photographic plates are available for recording topographs. Provisions are made for other types of photon detection as well as spectroscopy. The facilities for the entire station have been designed for remote operation using a LSI-11/23 plus suitable interfacing. These instruments will be described briefly and the current status of the program will be reviewed. The Appendix of this report presents titles, authors and abstracts of other technical work associated with this project during the current period.

8172 (IKF—41, pp 74-75) **Development of a 50 kV ion implantation facility with high transmission.** Baumann, H.; Bethge, K.; Moeschter, J.; Muenzer, R. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8173 (IKF—41, pp 77-78) **Construction of a 20 kV electron beam facility.** Langfeld, R.; Baumann, H.; Bethge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8174 (IKF—41, pp 82-84) **Measurements on space charge compensation of ion beams.** Kreisler, P.; Baumann, H.; Bethge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8175 (IKF—41, pp 84-85) **Development of a Penning ion source with magnetic octupole.** Brett, M.R.; Baumann, H.; Bethge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8176 (IKF—41, pp 86) **Oscillation behaviour of the plasma of a Penning ion source.** Rohwer, P.; Baumann, H.; Bethge, K.; Schuetze, W. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8177 (IKF—41, pp 90-91) **Proton beam deflection and current integration at PIXE measurements.** Hofmann, D.; Staudte, R.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8178 (Juel-Spez—146, pp 113) **Check of the ion optics of the focusing channel.** Aldea, L.; Brings, R.; Fiedler, R.; Reich, J.; Wucherer, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8179 (Juel-Spez—146, pp 114) **Data logging system at the cyclotron.** Brings, R.; Schlienkamp, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8180 (Juel-Spez—146, pp 116-117) **Modification of the double monochromator.** Reich, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8181 (Juel-Spez—146, pp 118) **Design of a RF-center region for multiharmonic mode operation.** Aldea, L.; Reich, J.; Wucherer, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8182 (Juel-Spez—146, pp 119) **Status of ISIS.** Beuscher, H.; Mayer-Boericke, C.; Reich, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8183 (Juel-Spez—146, pp 120-121) **ECR-plasma device at 2.45 GHz for test purposes.** Mathews, H.G.; Beuscher, H.; Fiedler, R. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8184 (Juel-Spez—146, pp 122) **Design of a magnetic lens for ISIS.** Bhandari, R.K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8185 (Juel-Spez—146, pp 123-124) **Check of the h = 3 RF-center region design by numerical calculation.** Aldea, L.; Wucherer, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8186 (Juel-Spez—146, pp 128) **Target laboratory.** Pfeiffer, J.; Riepe, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8187 (Juel-Spez—146, pp 128) **Test production of an ^{26}Al-target.** Buchmann, L.; Baumeister, H.; Rolfs, C.; Probst, H.J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8188 **(KFK—3198) Internal cluster beam target for antineutron production in LEAR.** Gspann, J.; Poth, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik). Oct 1981. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750357.

An internal hydrogen cluster beam target dedicated to antineutron production is proposed for installation in one of the bending magnets of LEAR. Running in the wedge-shaped gap in the center of the magnet, the cluster beam will intersect the antiproton beam vertically. The design target thickness is 2×10^{-10} g/cm^2, with lower values being readily available. The antineutron production rate is expected to be larger than $5.5 \times 10^{4-}$ n/s at 600 MeV/c and optimum target thickness. The cluster beam source will be located on top of the magnet together with its main pumping stages while the main sink stages will be placed below the magnet. Turbomolecular pumps will be used for pumping the higher gas loads at the source as well as for removing the main part of the beam flux. For the intermediate pumping stages, refrigerator cryopumps are proposed. Later installation of the facility in a long straight section of LEAR would be possible.

8189 **(SAND—82-1596C) Intense neutron source.** Walko, R.J.; Brainard, J.P.; Riedel, A.A.; O'Hagan, J.B.; Bacon, F.M. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 4p. (CONF-821123—4). NTIS, PC A02/MF A01. Order Number DE83002519.

From 7. conference on the application of accelerators in research and industry; Denton, TX, USA (8 Nov 1982).

A ScD_2 target film 5×10^{-5} m thick, tested in a UHV compatible 200 keV deuterium accelerator baked to 470°C, maintained a D-D neutron output rate of 1.0-1.2x10'' /s for 80 out of 140 hours of operation. This result demonstrates that a D-T neutron generator capable of a neutron output rate of 1×10^{13}/s and having a target lifetime suitable for cancer therapy is possible. Contrary to sputter rate data, ErD_2 target films appear to erode about twice as fast as ScD_2 films, making ErD_2 unsuitable as a target material. A low pressure ion source has been developed to replace the more complicated duopigatron. Experiments have verified that the single ring magnetic cusp ion source can deliver 200 mA of deuterium ions (≈ 60% D^+) at 10-15 A of arc current with a background deuterium pressure of 0.27-0.40 Pa. This source will improve the safety of a D-T machine by reducing the tritium inventory by a factor of 6, and by utilizing the Zr-Al getter as the gas reservoir.

8190 **Drift tube suspension for high intensity linear accelerators.** Clark, D.C.; Frank, J.A.; Liska, D.J.; Potter, R.C.; Schamaun, R.G. (to Department Of Energy). US Patent 4,350,921. 21 Sep 1982. Filed date 11 Mar 1980. vp.

PAT-APPL-129299.

The disclosure relates to a drift tube suspension for high intensity linear accelerators. The system comprises a series of box-sections girders independently adjustably mounted on a linear accelerator. A plurality of drift tube holding stems are individually adjustably mounted on each girder.

8191 **Means for the focusing and acceleration of parallel beams of charged particles.** Maschke, A.W. (to Department Of Energy). US Patent 4,350,927. 21 Sep 1982. Filed date 23 Sep 1980. vp.

PAT-APPL-189990.

Apparatus is described for focusing beams of charged particles comprising planar arrays of electrostatic quadrupoles. The array may be assembled from a single component which comprises a support plate containing uniform rows of poles. Each pole is separated by a hole through the plate designed to pass a beam. Two such plates may be positioned with their poles intermeshed to form a plurality of quadrupoles.

8192 **High intensity inverted sputter source.** Yntema, J.L.; Billquist, P.J. (Argonne National Lab., IL (USA)). *Nuclear Instruments and Methods in Physics Research;* **199**: No. 3, 637-638(15 Aug 1982).

The electrode structure of an inverted cesium sputtering negative ion source has been modified to produce a convergent Cs^+ beam. The intensities of negative ion beams produced with this electrode structure are approximately an order of magnitude greater than previously obtained.

8193 **Cyclotron axial ion-beam-buncher system.** Hamm, R.W.; Swenson, D.A.; Wangler, T.P. (to Dept. of Energy). US Patent Application 347,757. 11 Feb 1982. 15p. Contract W-7405-ENG-36.

Adiabatic ion bunching is achieved in a cyclotron axial ion injection system through the incorporation of a radio frequency quadrupole system, which receives ions from an external ion source via an accelerate-decelerate system and a focusing einzel lens system, and which adiabatically bunches and then injects the ions into the median plane of a cyclotron via an electrostatic quadrupole system and an inflection mirror.

8194 **Liquid hydrogen moderator on the ZING-P' pulsed spallation neutron source.** Carpenter, J.M.; Kleb, R.; Postol, T.A.; Stefiuk, R.H. (Argonne National Lab., IL (USA). Pulsed Neutron Source Program; Argonne National Lab., IL (USA). Solid State Science Div.); Mildner, D.F.R. (Missouri Univ., Columbia (USA). Research Reactor Facility). *Nuclear Instruments and Methods in Physics Research;* **189**: No. 2/3, 485-501(1 Nov 1981).

We describe the liquid hydrogen moderator on the ZING-P' pulsed spallation neutron source and present results of measurements to assess its performance in several configurations. Measurements were made with the moderator surrounded by a beryllium reflector, with and without a gadolinium decoupler, and also with a room temperature beryllium reflector-filter immediately downstream from the moderator. Results described include neutron beam spectra, pulse widths as a function of neutron energy, absolute neutron beam currents, and the nuclear heating rate. We compare our results with calculations and previous results of others.

8195 **Depolarization effects in optically pumped polarized proton sources.** Hinds, E.A. (Yale Univ., New Haven, CT (USA). Dept. of Physics); Cornelius, W.D.; York, R.L. (Los Alamos National Lab., NM (USA)). *Nuclear Instruments and Methods in Physics Research;* **189**: No. 2/3, 599-602(1 Nov 1981).

We discuss the electron spin depolarization of a hydrogen beam formed by charge capture in a polarized alkali vapor. An expression is derived for the final ground-state polarization of the hydrogen beam as a function of external-magnetic-field strength. This expression reveals the interesting possibility of producing a polarized beam with an unpolarized target. Some additional implications of our result for a practical polarized proton source are considered.

4304 Storage Rings

8196 **(DESY—81-066) Review of mini beta luminosities in PETRA at different energies.** Piwinski, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 6p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750358.

The mini beta operation with PETRA started in March 1981. Since that time many data were taken at 17, 11 and 7 GeV. The maximum luminosities, tune shifts, limitations etc. are summarized and compared in this note.

8197 **(DESY—82-026) Optimizing the degree of polarization in PETRA.** Bremer, H.D.; Kewisch, J.; Lewin, H.C.; Mais, H.; Rossmanith, R.; Schmidt, R.; Barber, D.P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 8p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE82750984.

A method is described for compensating the depolarizing effects caused by vertical orbit distortions. The technique has been successfully applied during measurements of beam polarization at PETRA and reproducible polarizations of 70 to 80% have been obtained both in single beam and colliding beam operation.

8198 **Injection system for CHEER.** Edwards, K.W. (Carleton Univ., Ottawa, Ontario (Canada). Dept. of Physics); Johnson, D.E.; Mills, F.E. (Fermi National Accelerator Lab., Batavia, IL (USA)); Skuja, A. (McGill Univ., Montreal, Quebec (Canada). Dept. of Physics). *Canadian Journal of Physics;* **59**: No. 11, 1797-1802(Nov 1981).

The injection system for CHEER must provide 34 bunches of 10^{11} electrons. We describe here a system consisting of a linear accelerator, accumulator-buncher ring, and a booster ring which can inject such bunches at 2 GeV into the main CHEER ring in an acceptably short time.

44 INSTRUMENTATION

REFER ALSO TO CITATION(S) 8149

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 8269, 8548, 8580, 8599

8199 **(BNL—31985) Characteristics of the new MPS II spectrometer system.** Etkin, A.; Foley, K.J.; Longacre, R.S. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1982. Contract AC02-76CH00016. 4p. (CONF-820718—19). NTIS, PC A02/MF A01. Order Number DE83002215.

From 21. international conference on high energy physics; Paris, France (29 Jul 1982).

Portions of document are illegible.

The BNL MPS II is a conversion of the spark chamber detector system of MPS I to a narrow drift space novel drift chamber system. A description is given of this very compact drift chamber system in which the electronics for individual channels is mounted on the chamber. Under actual experimental operating conditions, the chamber shows high resolution of $\approx$ 200 microns, are deadtime free, and yielded excellent performance. The digital electronics used eliminates channel-by-channel corrections. We have used it in a very large drift chamber system for which it is well suited since it requires less than one integrated circuit per channel. A description of the system, its testing, its use and results obtained in an experiment is presented and discussed.

8200 **(DESY—81-065) Measurement of wire tension in drift tubes by resonance in a magnetic field.** Hultschig, H.; Ladage, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750359.

Wire tension in drift chambers is commonly measured by observation of resonance frequency. In drift tubes, where the wire cannot be seen by eye, a vibration of the wire has to be detected in other ways. The method described here uses a simple bridge circuit for measuring the change in dc-resistance of the resonating wire. The decrease of the resistance (0.3%) is due to self-cooling (0.5°C) by convection when the wire starts swinging.

8201 **(DESY—82-030) ARGUS electron-photon calorimeter. Pt. 1.** Drescher, A.; Graewe, B.; Hofmann, W.; Markees, A.; Matthiesen, U.; Pollmann, D.; Spengler, J.; Wegener, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751063.

The performance of the ARGUS shower counters in detecting electromagnetic showers in the energy range 10...45 MeV is reported. When these results are considered with earlier measurements at GeV energies, it is seen that the device behaves almost like an ideal calorimeter over three decades in energy, with good linearity and a $1/\sqrt{E}$ dependence of the energy resolution. The detection threshold is at least as low as 10 MeV. Characteristics of low-energy electromagnetic showers, such as longitudinal shower profile and fraction of energy visible in the scintillator were measured, and are compared with results obtained from the EGS Monte-Carlo code.

8202 **(DOE/NV/01183—204-TP) Mercuric iodide (HgI_2) semiconductor devices as charged-particle detectors.** Becchetti, F.D.; Raymond, R.S.; Ristinen, R.A.; Schnepple, W.F.; Ortale, C. (Colorado Univ., Boulder (USA). Dept. of Physics; EG and G, Inc., Goleta, CA (USA)). 1981. Contract AC08-76NV01183. 22p. NTIS, PC A02/MF A01. Order Number DE83001662.

The properties of HgI_2 semiconductor devices as charged particle detectors have been investigated. Nearly linear energy response with FWHM resolution of 5 to 15% is observed for ^{1} ^{2}H and ^{3} ^{4}He ions, $E < 40$ MeV. Fast proton damage is observed for $> 10^{10}$ protons/cm^2. However, based on measurements with two HgI_2 detectors, little fast neutron damage is apparent at fluences up to 10^{15} neutrons/cm^2. This suggests considerably greater resistance to radiation damage than is observed for Si and other solid state devices.

8203 **(DOE/NV/01183—209-TP) Fabrication of HgI_2 nuclear radiation detectors by machine cleaving.** Levi, A.; Burger, A.; Schieber, M.; van den Berg, L.; Yelon, W.B.; Alkire, R.W. (EG and G, Inc., Goleta, CA (USA)). 1982. Contract AC08-76NV01183. 12p. NTIS, PC A02/MF A01. Order Number DE83002434.

A new device has been designed to facilitate the cleaving of thin sections from bulk crystals of mercuric iodide. Crystallographic perfection of the machine-cleaved sections was established by gamma-ray diffraction rocking curves and was found to be higher than the perfection of hand-cleaved sections or of as-grown thin platelets, approaching the perfection of string-sawn sections of HgI_2. A correlation was found between the perfection and thickness of the machine-cleaved sections, i.e., the thicker the section the more perfect it is. Reproducibility of the fabrication was significantly improved by using machine cleaving in the fabrication process.

8204 **(DOE/NV/01183—211-TP) Low-temperature photoluminescence of detector-grade HgI_2.** Merz, J.L.; Wu, Z.L.; van den Berg, L.; Schnepple, W.F. (EG and G, Inc., Goleta, CA (USA)). 1981. Contract AC08-76NV01183. 43p. NTIS, PC A03/MF A01. Order Number DE83002428.

Portions of document are illegible.

The low-temperature photoluminescence of HgI_2 is reported. Three main luminescence bands are observed, with peaks at $\sim$ 2.30, 2.20, and 2.00 eV at 77 K. At 4.2 K, the highest energy peak shows considerable structure. The temperature dependence of these lines indicates both free and bound exciton recombination, and very small exciton binding energies ($\sim$ 3 to 5 MeV) have been estimated. A comparison of the results of sublimation and doping experiments suggests that the lowest energy band may be related to impurities, whereas the middle-energy band is related to I content. The two strongest bound exciton lines comprising the high-energy band show systematic correlations with the middle-energy, I-related band. Further correlations between these spectral features and the performance of nuclear radiation detectors fabricated from these

samples are also noted. The temperature coefficient of the band gap is estimated from the spectral shift of luminescence lines to be approximately -1.13 x 10^{-4} eV/K between 32 K and 45 K.

8205 **(DOE/NV/01183—212-TP) Search for improved surface treatment procedures in fabrication of HgI_2 x-ray spectrometers.** Levi, A.; Burger, A.; Nissenbaum, J.; Schieber, M.; Burshtein, Z. (Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology; Negev Nuclear Research Centre, Beersheba (Israel)). 1980. Contract AC08-76NV01183. 14p. NTIS, PC A02/MF A01. Order Number DE83002424.

The influence of various fabrication parameters on the surface quality of HgI_2 x-ray spectrometers was studied in detail. Exposure of etched HgI_2 to ambient atmosphere for ~ 24 hours may reduce the electron surface recombination velocity by almost an order of magnitude. Reduction of the etching solution temperature (KI in water) to about 0°C and an increase of the KI concentration to ~ 20 wt % are also important.

8206 **(DOE/NV/01183—214-TP) Gamma-ray spectrometry with thick mercuric iodide detectors.** Beyerle, A.; Hull, K.; Markakis, J.; Lopez, B.; Szymczyk, W.M. (EG and G, Inc., Goleta, CA (USA)). 1982. Contract AC08-76NV01183. 21p. NTIS, PC A02/MF A01. Order Number DE83002426.

Gamma-ray spectra with energies up to 1.3 MeV have been detected for the first time with 1-cm-thick HgI_2 semiconductor detectors at room temperature. The spectra can be taken using a long, 10 μs, or a short, 0.5 μs, charge collection time. The latter has produced better results with better peak efficiency, higher peak-to-valley ratio, and fewer low energy counts with little sacrifice in resolution. Spectra for energies between 100 keV and 1.3 MeV and descriptions of the techniques for their acquisition are presented. The thick detectors need a conditioning treatment, which is described, prior to showing spectral response.

8207 **(GKSS—82/E/7) Dimensional measurements by means of neutron radiography image.** Soare, C. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1982. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750959.

This report presents a fitting procedure for dimensional measurements using the density curve of a neutron radiography image. The measured values of the film density are correlated with a 'model' function representing the actual shape of the object, by means of a spread-function. By the least squares method the parameters of the model function are estimated, and then, the dimension can be evaluated. The report also presents the results obtained by this procedure for a real case.

8208 **(GSF-K—86) Experiments in radiochemistry.** Schwankner, R. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Nov 1980. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750704.

Twelve experiments in radiochemistry, nuclear chemistry, radiation detection and radiation measurement are presented which have been tested in teaching practice. Criteria of selection were minimum apparative expenditure, preparation time, radiation exposure, and danger of incorporation or contamination. The experiments will teach students how to handle unsealed radioactive materials within a fraction of a permissible values and thus train them in radiochemical techniques of working. Theoretical, historical and topical aspects are mentioned in order to give the students some background. A detailed bibliography of relevant publications is given.

8209 **(GSF-S—785) GSF secondary standard dosimetry laboratory for photon and beta radiation.** Eckerl, H.; Nahrstedt, U. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). May 1981. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750736.

Brief outline of the Lab's tasks and detailed description of its layout and equipment.

8210 **(IKF—41, pp 52-56) Solid-state particle track detectors and their application.** Schopper, E. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8211 **(IKF—41, pp 87-88) Detector development at the time-of-flight spectrometer of the GSI.** Bass, R.; Noll, H.; Odenweller, T.; Sapotta, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8212 **(IKF—41, pp 89-90) Development of an electron spectrometer with position sensitive electron detector.** Frischkorn, H.J.; Koschar, P.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8213 **(IKF—41, pp 93-94) Parallel plate counter for nuclear physics experiments with intermediate mass ions.** Gerl, J.; Blumenstock, T.; Elze, T.W.; Ronge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8214 **(IKF—41, pp 96-97) Four detector NaI Compton polarimeter for quasi-continuous gamma radiation.** El Sheikh, A.; Bass, R.; Weniger, R. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8215 **(Juel—1728) Numerical and experimental investigations to describe the mode of operation and effectivity of large surface high sensitive SPNDs (Self-Powered-Neutron-Detectors).** Al-Dabagh, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Aug 1981. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750360.

First a computer model for the parametric calculation of the (n,γ)-reaction rates in the emitter of the SPND was developed under use of the Monte-Carlo Program KENO II. To determine the escape-probability of the electrons produced via Compton- or photoelectric effect by the emitter as well as from the surrounding isolator, a new Monte-Carlo-Program was implemented under consideration of the Klein-Nishina-formula and the energy-range relationships for electrons. The approximate calculations performed for the electrons produced in the isolator show that the 'isolator flux' can give an important contribution to the total signal of the SPND. Subsequently with this program system an optimization of the neutron sensitivity was performed by a suitable choice of geometry (emitter thickness, isolator thickness). For a specially built large surface SPND with Gadolinium-emitter the neutron sensitivity was calculated. These results were checked by an In-Pile-Experiment in the FRJ-1 reactor. Very good agreement was found. The detector was also shown to exhibit excellent linearity and showed also the expected enhanced sensitivity.

8216 **(Juel-Spez—146, pp 114-115) New emittance measuring device.** Brings, R.; Wucherer, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8217 **(Juel-Spez—146, pp 125) Magnet spectrometer BIG KARL.** Katayama, I.; Koehler, M.; Styczen, B.; Berg, G.P.A.; Hacker, U.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Roemer, J.G.M.; Rogge, M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8218 **(Juel-Spez—146, pp 125) Reduction of background and improvement of resolution by use of time and angle information of particles detected in BIG KARL.** Decowski, P.; Mayer-Boericke, C.; Morsch, H.P.; Rogge, M.; Zemlo, L. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8219 (Juel-Spez—146, pp 127) **Semiconductor detectors.** Hamacher, A.; Kuenster, T.; Lawin, E.; Metz, H.; Nicoll, K.; Protic, D.; Riepe, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8220 (Juel-Spez—146, pp 129) **Measurement of perturbed angular correlations at JOSEF.** Chatzipetros, J.; Borgs, W.; Lawin, H.; Sistemich, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8221 (Juel-Spez—146, pp 130-131) **Superconducting solenoid.** Ercan, A.; Katayama, I.; Zupancic, M.; Retz, A.; Rindfleisch, U.; Nagai, Y.; Kleinheinz, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8222 (Juel-Spez—146, pp 132-133) **New spectrograph for experiments with low energy pions at TRIUMF.** Wiedner, C.A.; Martin, S.A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8223 (Juel-Spez—146, pp 135) **Electronic division.** Labus, H.; Bojowald, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8224 (Juel-Spez—146, pp 137) **Design and mechanical workshop.** Briell, W.; Gross, D.; Ramacher, K.H.; Retz, A.; Rindfleisch, U.; Schwan, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8225 (KFK—3160) **New experimental techniques.** Fluegge, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Oct 1981. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750361.

New developments in experimental techniques for elementary particle detectors are described. Tracking devices, calorimeters, and particle identification are discussed.

8226 (KFK—3231) **α-Monitor(rotating drum cell) - an in-line instrument for continuous measuring α-activity.** Groll, P.; Brenk, O.; Guettle, G.; Persohn, M.; Radek, S.; Roeder, L.; Roemer, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Mar 1982. 31p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750734.

In this report the documentation for the installation of the α-monitor in a reprocessing facility is given. The mechanics of the apparatus is described as well as the electronics. In detail the conditions for normal operation and hints for trouble-shooting are given.

8227 (KFK-AFR—003, pp 7) **Mass flow measurements in two-phase flows.** Loeffel, R. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8228 (KFK-AFR—003, pp 21-22) **Gamma transmission analysis in materials-handling technology.** Pepelnik, R.; Fanger, H.U. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8229 (LBL—14414) **Design considerations for a high-spatial-resolution positron camera with dense-drift-space MWPC's.** Del Guerra, A.; Perez-Mendez, V.; Schwartz, G.; Nelson, W.R. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, CA (USA)). Oct 1982. Contract AC03-76SF00098. 14p. (CONF-821011—17). NTIS, PC A02/MF A01. Order Number DE83003051.

From IEEE nuclear science symposium; Washington, DC, USA (20 Oct 1982).

Portions of document are illegible.

A multiplane Positron Cameris is proposed, made of six MWPC modules arranged to form the lateral surface of a hexagonal prism. Each module (50 x 50 cm^2) has a 2 cm thick lead-glass tube converter on both sides of a MWPC pressurized to 2 atm. Experimental measurements are presented to show how to reduce the parallax error by determining in which of the two converter layers the photon has interacted. The results of a detailed Monte Carlo calculation for the efficiency of this type of converter are shown to be in excellent agreement with the experimental measurements. The expected performance of the Positron Camera is presented: a true coincidence rate of 56,000 counts/s (with an equal accidental coincidence rate and a 30% Compton scatter contamination) and a spatial resolution better than 5.0 mm (FWHM) for a 400 μ Ci point-like source embedded in a 10 cm radius water phantom.

8230 (MPI-PAE/Exp.El.—104) **Silicon counter telescope to study short-lived particles in high-energy hadronic interactions.** Hyams, B.; Koetz, U.; Belau, E.; Klanner, R.; Lutz, G.; Neugebauer, E.; Wylie, A.; Kemmer, J. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). Jun 1982. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751064.

A telescope consisting of six silicon microstrip detectors achieving 5 μm spatial resolution for minimum ionizing particles has been built. The design and fabrication of the counters, electronics, and mechanical set-up is described, and first results of its performance in a 175 GeV/c beam are reported.

8231 (ORNL/TM—8475) **Mobile gamma-ray scanning system for detecting radiation anomalies associated with ^{226}Ra-bearing materials.** Myrick, T.E.; Blair, M.S.; Doane, R.W.; Goldsmith, W.A. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 85p. NTIS, PC A05/MF A01. Order Number DE83003352.

Portions of document are illegible. Printed copy available until stock is exhausted.

A mobile gamma-ray scanning system has been developed by Oak Ridge National Laboratory for use in the Department of Energy's remedial action survey programs. The unit consists of a NaI(T1) detection system housed in a specially-equipped van. The system is operator controlled through an on-board mini-computer, with data output provided on the computer video screen, strip chart recorders, and an on-line printer. Data storage is provided by a floppy disk system. Multichannel analysis capabilities are included for qualitative radionuclide identification. A ^{226}Ra-specific algorithm is employed to identify locations containing residual radium-bearing materials. This report presents the details of the system description, software development, and scanning methods utilized with the ORNL system. Laboratory calibration and field testing have established the system sensitivity, field of view, and other performance characteristics, the results of which are also presented. Documentation of the instrumentation and computer programs are included.

8232 (PB—82-210279) **Progress in high-dose radiation dosimetry. Final report.** Ettinger, K.V.; Nam, J.W.; McLaughlin, W.L.; Chadwick, K.H. (National Bureau of Standards, Washington, DC (USA)). 1981. 28p. Pub. in Proceedings of International Symposium on Biomedical Dosimetry: Physical Aspects, Instrumentation, and Calibration, Paris, France, October 1980, p405-432 1981.

The last decade has witnessed a deluge of new high-dose dosimetry techniques and expended applications of methods developed earlier. Many of the principal systems are calibrated by means of calorimetry, although production of heat is not always the final radiation effect of interest. Requirements for a stable and reliable

transfer dose meters have led to further developments of several important high-dose systems: thermoluminescent materials, radiochromic dyes, ceric-cerous solutions analyzed by high-frequency oscillometry. A number of other prospective dosimeters are also treated in this review. In addition, an IAEA program of high-dose intercomparison and standardization for industrial radiation processing is described.

8233 **(PB—82-210832) Possible use of electron spin resonance of polymer films containing leucodyes for dosimetry. Final report.** Uribe, R.M.; McLaughlin, W.L.; Miller, A.; Dunn, T.S.; Williams, E.E. (National Bureau of Standards, Washington, DC (USA)). 1981. 6p. Pub. in Proceedings International Meeting (3rd) on Radiation Processing, Tokyo, Japan, Oct 26-30, 1980, paper in Radiation Physics and Chemistry 18, n5-6 p1011-1016 1981.

When plastic films containing leucocyanides of triphenylmethane dyes are irradiated with large doses of (60)Co gamma rays, free radicals are formed that are sufficiently stable for analysis at room temperature. It is shown that by separating the electron spin resonance spectrum due to free radicals produced in the polymeric host materials from that of the dye precursor, the number of spins associated with a free radical produced in the substituted triphenyl methyl radical can be determined as a means of dosimetry. Instabilities in the free radical populations are evaluated, and methods of preparing plastic films containing triphenylmethane leucodyanides are described. Not only can dosimetry be achieved at higher doses than are normally used with spectrophotometry of this films, but also information about the radiation chemistry of dye formation can be derived.

8234 **(PB—82-211079) Evaluation of radiochromic dye films and other plastic dose meters under radiation processing conditions. Final report.** Miller, A.; McLaughlin, W.L. (National Bureau of Standards, Washington, DC (USA)). 1981. 20p. Pub. in Proceedings of Conf. on High-Dose Measurements in Industrial Radiation Processing, Vienna, Austria, Sep 25-29, 1978, Tech. Rept. Ser. 205, p119-138 1981.

Selection of dose meters for industrial irradiation purposes is mainly based on the specific dosimetry needs of the individual irradiation processes, weighed against knowledge of the well-documented behavior of the dose meters in question. These selection criteria are briefly discussed. A comprehensive study is made of radiochromic dye dose meters with respect to the data needed in making a meaningful evaluation of their merits and faults. Part of the program has been carried out for several types of radiochromic dye films, as well as red, amber and clear Perspex dose meters, and the results of these measurements are given.

8235 **(RRC—47) Liquid scintillation (NE-213) spectrometer for fast neutrons.** Ganguly, P.A.; Venkatesam, V. (Reactor Research Centre, Kalpakkam (India)). 1981. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83900582.

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This report presents the details of a liquid scintillation spectrometer for fast neutron (1 to 15 MeV) spectrometry. The report deals with scintillator response for various charged particles, pulse shape discrimination of neutrons and gamma rays, and pulse height analysis of charged particles with special emphasis on the electronic circuitry for pulse shape discrimination. Also presented are the experimental details of test measurements. The neutron spectra of ^{241}Am-Be and ^{239}Pu-Be sources are measured and compared with the published results. The details of derivative-cubic spline unfolding code DUST used to obtain the neutron spectrum are presented.

8236 **Highly sensitive energy-dispersive X-ray spectrometer with multiple total reflection of the exciting beam.** Schwenke, H.; Knoth, J. Geesthacht-Tesperhude, Germany; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1982). 5p. (GKSS—82/E/17).

The design features of a new type of energy-dispersive X-ray fluorescence spectrometer are described. The instrument is characterized by a simple X-ray optics composed of two quartz mirrors and diaphragms which direct the grazing incoming beam from a fine structure tube in a zig-zag path to an easily exchangeable third quartz mirror used as the sample support. Total reflection of the exciting beam on the sample support results in an evident reduction of scattering and thus of the background under the X-ray peaks in the fluorescence spectrum. Detection limits below 10sup(-11) or 0.1 ppb, respectively, are achieved with this technique for about 20 elements in aqueous solutions. Usually, quantitative analyses are performed using a thin sample film with an internal standard. An analysis of airborne particles collected on a filter is described as an example of its application.

8237 **Irvine-Michigan-Brookhaven (I.M.B.) nucleon decay search status report.** Bratton, C.B. (Univ. of California, Irvine); Gajewski, W.; Kropp, W.R. pp 84-97 of Second workshop on grand unification. Leveille, J.P.; Sulak, L.R.; Unger, D.G. (eds.). Boston, MA; Birkhaeuser (1981).

From 2. workshop on grand unification; Ann Arbor, MI, USA (24 Apr 1981).

The Irvine-Michigan-Brookhaven collaboration is currently constructing a 8700 tonne water Cerenkov detector to measure, or establish a lower limit to, the nucleon lifetime. The detector, which should be complete by the middle of October, is located at a depth of 1670 m.w.e. in the Morton Salt Mine near Cleveland, Ohio. Activities during the past year have been dominated by the construction of the laboratory and of the phototube, electronic and software systems. In house tests of the phototubes and data acquisition chain have demonstrated their reliability, the feasibility of on-line rejection of cosmic ray muons, and have yielded information relevant to off-line methods of event reconstruction. This report will concentrate on these activities and point out where actual experience or measurement has confirmed or modified features of the proposed detector as described previously in several articles.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 8169

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 6748, 7914, 8001, 8171, 8883

8238 **(BDX—613-2774) Gas analysis by time-of-flight mass spectrometry. Final report.** Smith, R.E. (Bendix Corp., Kansas City, MO (USA)). Nov 1982. Contract AC04-76DP00613. 12p. NTIS, PC A02/MF A01. Order Number DE83003315.

Analytical methods for the determination of gases by time-of-flight mass spectrometry have been developed. Instrument operating parameters have been evaluated. The basic principles of operation are described. The analysis of standard nitrogen, argon, and helium gases are compared. This method is particularly suited for hydrogen determination. The amount of time required for instrument warm-up was either two or six hours, depending on whether the instrument was kept in the stand-by mode overnight. The reproducibility of the time-of-flight mass spectrometry was found to be 4.3 percent relative standard deviation.

8239 **(BNL—32095) Optimized stage design for x-ray-fluorescence analysis in the SEM.** Warren, J.B.; Kraner, H.W. (Brookhaven National Lab., Upton, NY (USA)). Oct 1982. Contract AC02-76CH00016. 7p. (CONF-820409—5). NTIS, PC A02/MF A01. Order Number DE83003174.

From Scanning electron microscopy annual meeting; Anaheim, CA, USA (Apr 1982).

Portions of docuemnt are illegible.

If one of the final apertures is replaced with a thin foil target, a scanning electron microscope (SEM) can be used as a transmission x-ray tube for energy dispersive x-ray analysis. Potentially, energy dispersive x-ray spectra (EDS) from such a system will have a much improved signal-to-noise ratio whem compared to electron-probe excited spectra. In the typical SEM, the utility of this method is limited because the x-ray beam exiting from the target foil is poorly collimated and is extensively scattered by the massive specimen stage. This problem has been eliminated in the

AMR 1000A by mounting a collimator in the final pole-piece to reduce the x-ray beam diameter and redesigning the specimen stage so that only lowmass, low-Z materials are struck by the x-ray beam. The effect of x-ray excitation efficiency, target foil thickness, sample mounting materials, and stage alignment on system sensitivity is described.

8240 **(DESY-SR—81/10) Spectrometer for X-ray energy-dispersive diffraction using synchrotron radiation.** Buras, B.; Gerward, L.; Staun Olsen, J.; Steenstrup, S. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750362.

The paper describes a white-beam X-ray energy dispersive diffractometer using the synchroton radiation from the DORIS ESR. The following features of the instrument are discussed: Horizontal or vertical scattering plane, collimators, sample environment, remote control of gonimeter, data acquisition, energy-sensitive detectors using small-area and large-area detector crystals, modes of operation, powder and single crystal diffraction. An example is given from a high-pressure study of YbH_3 using a diamond anvil cell.

8241 **(HMI-B—360) HDLC communication processor.** Brehmer, W.; Wawer, W. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik). Sep 1981. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750437.

Systems for data acquisition and process control may comprise several intelligent stations with local computing power, each of them performing specific tasks in the control system. These stations generally are not independent of each other but are interconnected by the process being monitored or controlled. Therefore they must communicate with each other by transmitting or receiving messages which may contain instructions directed to the control system, status information and data from peripheral devices, variables which synchronize the execution of programs in the autonomous intelligent stations, and data for man-machine communication. This report describes a microprocessor based device which interfaces the I/O port of a host computer (CAMAC Dataway) to an HDLC bus system. The microprocessor (M6800) performs the HDLC protocol for a Multi-Point Unbalanced System.

8242 (IKF—41, pp 91-92) **Target wheel guidance.** Hofmann, D.; Staudte, R.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8243 **(KFK—3215) Tests of an advanced true mass flow meter in gas liquid flow.** John, H.; Hain, K.; Bruederle, F.; Reimann, J.; Schloss, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Oct 1981. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83780177.

A True Mass Flow Meter (TMFM 50) designed for measuring two phase mass flow rate up to 50 kg/s has been developed and tested in the KfK for the use in a KfK transient two phase flow loop as a reference measurement device. The report briefly describes the device, the test loop, the testing procedure and mainly the test results. The test showed that the measuring error is less than +-1.5% related to full flow, when the gas content is not known and less than +-0.5% with known gas content x of the flow. The pressure loss will be shown dependent from the operation conditions.

8244 **(SAND—82-8829) Real-time particulate mass analyzer for pressurized fluidized bed combustion exhaust applications.** Wang, J.C.F.; Libkind, M.A. (Sandia National Labs., Livermore, CA (USA)). Nov 1982. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01. Order Number DE83003076.

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At Sandia National Laboratories in Livermore, California, we have developed a new particulate mass analyzer and have demonstrated its real-time measuring capability in an actual pressurized fluidized-bed combustor environment. The analyzer incorporates a set of cyclones, each with its own tapered-element, oscillating microbalance. During measurements, the temperature and pressure of the sampled gas are kept at the process-stream conditions. With the system, real-time particle mass-loading and size-fraction measurements have been obtained for the first time downstream from hot-gas cleanup equipment continuously for four hours. The resulting data contributed to an early assessment of the performance of the cleanup equipment.

8245 **General-purpose temperature controller.** Handschy, M.A. (Univ. of Colorado, Boulder). *Journal of Physics E: Scientific Instruments;* **13**: 998-1001(1980). Contract AC02-76ER02203.

A simple, inexpensive temperature controller is described. This controller is capable of maintaining temperatures constant to less than 100 μK in a variety of thermostats. It uses a thermistor in a DC Wheatstone bridge. The simplicity of DC detection allows the use of readily available electronic components, and ensures a low total cost. Furthermore, thermostatting of the electronics is generally not necessary.

8246 **Prospects for extending the resolution limit of the electron microscope.** Glaeser, R.M. (Univ. of California, Berkeley). *Journal of Microscopy (Oxford);* **17, Pt. 1**: 77-91(Sep 1979). Contract W-7405-ENG-48.

The factors that limit the performance of present-day high-resolution electron microscopes include the source brightness, the temporal coherence of the illumination, and phase contrast "artefacts" due to spherical aberration and defocus. Further advancement of the instrumental performance might be accomplished in different ways, including the use of high coherence conditions combined with image restoration; the use of higher accelerating voltages; the use of aberration correctors; or the use of conditions for incoherent image formation. Current efforts in each of these directions are reviewed, from which it is evident that the presently leading to the greatest degree of progress.

8247 **Optical design and performance of a dual-grating, direct-reading spectrograph for spectrochemical analyses.** Steinhaus, D.W.; Kline, J.V.; Bieniewski, T.M.; Dow, G.S.; Apel, C.T. (Los Alamos Scientific Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **190**: 454-460(1979).

From LASL conference on optics '79; Los Alamos, NM, USA (23 May 1979).

An all-mirror optical system is used to direct the light from a variety of spectroscopic sources to two 2-m spectrographs that are placed on either side of a sturdy vertical mounting plate. The gratings were chosen so that the first spectrograph covers the ultraviolet spectral region, and the second spectrograph covers the ultraviolet, visible, and near-infrared regions. With the over 2.5 m of focal curves, each ultraviolet line is available at more than one place. Thus, problems with close lines can be overcome. The signals from a possible maximum of 256 photoelectric detectors go to a small computer for reading and calculation of the element abundances. To our knowledge, no other direct-reading spectrograph has more than about 100 fixed detectors. With an inductively-coupled-plasma source, our calibration curves, and detection limits, are similar to those of other workers using a direct-reading spectrograph.

45 EXPLOSIONS AND EXPLOSIVES

REFER ALSO TO CITATION(S) 8066

8248 **Venting processes: Effects on the vicinity.** Hattwig, M. Berlin, Germany, F.R.; Bundesanstalt fuer Materialpruefung (1980). vp. (In German).

In the case of venting as a protective measure against explosions a dangerous pressure wave and a large flame must be expected in the neighbourhood of the vent. Moreover the recoil force which is exerted on the protected vessel can be the cause for the destruction of the plant. Therefore experiments have been made on the dependence of the pressure wave and the recoil force from well-known or easily determinable parameters. The results of the investigations allow the estimation of the maximum overpressure which must be expected at a given point outside the vessel, if the reduced explosion pressure which will be reached in the interior of the vessel is known. Beyond that it could be shown that the maximum recoil force is nearly always considerably smaller than the value given by theory. Only very rarely the theoretical value is reached. Therefore it is totally sufficient for practical purposes when the maximum recoil to be expected is calculated from the theoretical equation.

4501 Chemical

8249 **(AD-A—114787/5) Small-scale explosion experiments, seismic source calculations and summary of current research. Quarterly technical report 1 Jan-31 Mar 79.** Coleman, P.L.; Day, S.M.; Rimer, N.; Cherry, J.T.; Murphy, J.R. (Systems, Science and Software, La Jolla, CA (USA)). May 1979. 47p. NTIS, PC A03/MF A01.

Brief summaries of work currently underway or completed in the period from 1 January to 31 March 1979 are presented. One describes the development and testing of small spherical charges which will be emplaced in concrete blocks in the laboratory to simulate large explosions. A second section discusses an analysis of the free-field data from the MERLIN event. The other three sections are concerned with finite difference simulations of explosion and earthquake sources. These include results from calculations of PILEDRIVER and of decoupled explosions in salt. Also is described is a fracture criterion for three-dimensional finite difference modeling of earthquake faulting.

8250 **(LA—9415-C) Proceedings of the sixth annual joint-firing-systems conference.** Baker, D.D.; Muir, J.E. (comps.). (Los Alamos National Lab., NM (USA)). Sep 1982. Contract W-7405-ENG-36. 315p. (CONF-811176—). NTIS, PC A14/MF A01. Order Number DE83001933.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

Portions of document are illegible. Printed copy available until stock is exhausted.

Nineteen papers were presented at the meeting. A separate abstract was prepared for each of 17 papers. Two papers were previously processed for inclusion in the Energy Data Base. (LCL)

8251 (LA—9415-C, pp 1-16) **Application of precision firing.** Manke, P.L. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

The goal of precision firing is to develop a low-jitter multiple Capacitor Discharge Unit (CDU) system in which the CDUs can be separately triggered. This type of CDU system is necessary if an accurate time delay between the firing of different loads is to be accomplished. Precision firing is now being applied to the Wireless Barrier program to establish a fixed time delay between the firing of two separate CDUs. The timing circuit that determines this time delay is fixed to the required value by trimming a resistor when the circuit board is assembled. Other types of time-delay circuits have been evaluated, which will allow for a variable time delay depending on the temperature of the system.

8252 (LA—9415-C, pp 17-20) **In-line fuzing development for tactical airfield attack munition (TAAM).** Morrison, J.J. (Lawrence Livermore National Lab., CA). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

The shock-hardened new-concept safing, arming, and in-line fuzing system developed for US Air Force modular weapons is being advanced for the Tactical Airfield Attack Munition (TAAM) as an alternate fuzing system. The high power slapper detonator system is being reduced in volume by an approximate factor of 10 and the energy by a factor of 3. In addition, the fuze has the capability of functioning after many hours of delay to provide area-denial capabilities.

8253 (LA—9415-C, pp 21-32) **Low inductance CDU studies.** Royer, E.P. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

A low source inductance CDU has been fabricated and tested which uses an extended-foil, dry-wrap mylar storage capacitor. The capacitor is wrapped on a glass-epoxy cylindrical mandrel which allows the trigger and transverter circuitry to fit inside the capacitor. This capacitor was designed to have 2.0 μF capacitance and operate up to 6.0 kV dc.

8254 (LA—9415-C, pp 33-48) **Direct slapper initiation of IHE, Part I.** Hemsing, W.F.; Carlson, L.A. (Los Alamos National Lab., NM). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

We are endeavoring to slapper initiate insensitive high explosives (IHE) with a weaponizable amount of firing-set energy. Blends of pure TATB and HMX or RDX are being used in this work. Our experimental results are reported. Significant reductions in required firing-set energy have been obtained by closely coupling the capacitor trigger and slapper. Excellent spreading in the hemispherical booster pellet is shown.

8255 (LA—9415-C, pp 49-52) **Development of an integral flat cable/slapper detonator system.** McCormick, R.N. (Los Alamos National Lab., NM). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

The concept of an integral flat cable/slapper detonator will be described. Several designs presently being worked on will be presented.

8256 (LA—9415-C, pp 53-58) **Light transmission through fireset foam and barrier materials.** Hessel, K.R. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

For some fireset configurations, and similar weapon applications as well, it would be advantageous to transmit weapon communications signals directly through fireset foam materials and/or fireset barriers, in all cases doing this without affecting the mechanical integrity of the material. This can be done. It was found that infrared signals can be reliably transmitted directly through at least several inches of 5-lb and 20-lb foam, through up to an inch or so of MXB-71, and through holes in aluminum fireset barriers smaller than 25 μ in diam.

8257 (LA—9415-C, pp 59-74) **In situ diagnostics of hemispherical detonators by pattern recognition.** Hayes, B. (Lawrence Livermore National Lab., CA). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

Electrical signal waveforms obtained from the outer aluminum surface of hemispherical detonators are used to measure event times associated with bridges, low- and high-density explosives comprising these cascade process devices. The energy source for the electric signal is the charged condenser in the firing set. Transient electric fields, upon circuit closure, permeate the dielectric volume inducing electron charge migration over the surface of the retainer cup. The equivalent detection circuit consists of a source capacitively coupled to a low impedance resulting in differentiated charge coupling. Characteristic patterns, caused by the sequence of changing events from switch breakdown to detonator breakout, are readily recognized. The major events observed are the function time of the spark gap or krytron switch, the function time of the bridge including the melt phase and the explosive transit time from bridge burst to breakout. With a relatively long firing line, the transition from low-density to high-density explosive can also be identi-

fied. Recent examples of the pattern recognition technique, applied to a three-stage hemispherical detonator under laboratory and simulated firing conditions for ambient and low temperatures, are presented.

8258 (LA—9415-C, pp 75-86) **VISAR.** Hemsing, W.F. (Los Alamos National Lab., NM). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

Our modified VISAR acquires velocity information using two signals, rather than the usual three. These signals are of a form that permits greatly simplified data reduction. Presented here is a description of our data-reduction program for use with a small computer. Its use requires a training period of only 15 minutes; data reduction takes 10 minutes per shot.

8259 (LA—9415-C, pp 97-140) **MSAD developmental tester.** Clark, R.N. (Lawrence Livermore National Lab., CA). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

Computer-based testing is essential for the development of the MSAD booster assembly. This system utilizes eddy current transducers for displacement measurements from which wheel rotation, friction, stiction and eccentricity are obtained. Voltage and current are measured to determine actuator performance and to calculate coil temperature. Fiber optics are employed to determine wheel position. The technology advances that have been made using this system are directly applicable to a production line tester.

8260 (LA—9415-C, pp 173-202) **Round vs flat bridgewires: a comparison of pressure wave outputs.** Palmer, H. (Lawrence Livermore National Lab., CA). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

One-and-two dimensional calculations have been performed to model pressure waves generated in low-density explosive by exploding bridgewires. The objective of the calculations was to see how the bridgewire geometry influences the attenuation of pressure waves as they progress into an explosive. Only a relative comparison of bridgewire geometry effects was desired, so very simple approximations to real material properties were used in the calculations. The expanding bridgewire was modeled by a gamma-law equation-of-state with an initial pressure of about 3 GPa, (consistent with estimates of initial pressure generated by exploding bridgewires). The low-density explosive was modeled using an equation-of-state for polyethylene and the properties of an alumina header were approximated by a rigid wall rear boundary condition. The calculations show that although the pressure pulses from round and flat bridgewires are quite different, compensating mechanisms tend to make them equivalent in their ability to initiate explosives. The flat bridgewire geometry produces short duration pulses compared to round bridgewires, but the peak pressure is higher and attenuates more slowly for the flat bridgewires because edge rarefactions must travel farther to reach the symmetry plane. Since the initiation threshold of explosives depends on both pressure and pulse duration, the short pulse produced by the flat bridgewire is compensated by the higher pressure. The one-dimensional calculations are used as a limiting case comparison for the flat bridgewire two-dimensional calculations.

8261 (LA—9415-C, pp 203-226) **Analysis of pre-burst temperature distribution in exploding bridgewire foils.** Madsen, N.K. (Lawrence Livermore National Lab., CA). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

A computer simulation has been performed to analyze the transient temperature distributions in electrically exploded bridgewires. The physical models employed are valid until shortly before the time of burst. Various bridgewire geometries have been studied in an attempt to obtain uniform bridge heating during the pre-burst period.

8262 (LA—9415-C, pp 227-244) **Failure studies on low-voltage flying plate detonators.** Jacobson, A.K.; Kennedy, J.E. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

Sandia performed a substantial amount of development work on flying plate detonators for weapon applications. These detonators operate by hotwire ignition of a pyrotechnic material, which leads to burning of an adjacent explosive material. The gas pressure developed in the burning reaction is used to shear and accelerate an aluminum plate to a velocity of about 1 km/s over a displacement of 1 cm or less. Impact of this flying plate with an explosive assembly is intended to shock-initiate detonation of the explosive. Sporadic failures of the flying plate to initiate detonation were seen with one type of detonator. Several approaches were taken to determine the cause(s) of these failures and attempts were made to reproduce the failures. The velocity and tilt of the flying plate were measured by VISAR and flash x-ray. Transit times of detonation in explosive acceptor pellets were measured. Analyses and experiments were performed to determine the extent of precompression of the acceptor explosive due to shocks transmitted along the device ahead of the burning donor charge, and due to compression of gases ahead of the flying plate. Design changes were investigated. Intentional flaws were introduced into some units to determine whether severe flyer tilt or blowby of propellant gases could lead to failure to detonate. We were unable to duplicate the failures or to definitively isolate their causes. Our conclusion is that the margin over threshold stimulus for initiation of detonation was inadequate for high reliability in one type of design. Recommendations are offered concerning design features and performance measurements worthy of special attention in future development efforts.

8263 (LA—9415-C, pp 245-260) **All-secondary explosive flying-plate detonators.** Dinegar, R.H. (Los Alamos National Lab., NM). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

PETN and HMX explosives can be ignited by a hot wire. In deflagrating under confinement they generate gas pressures sufficient to rupture thin aluminum disks. These flying plates reach a velocity high enough to initiate secondary explosives upon impact. The mass and size of the PETN or HMX donor charge can vary considerably and the igniter will function if the explosive is highly compacted. Short lengths of PETN, HMX and HNS can be used as acceptor explosives and be initiated to detonation by a flying plate over a wide range of pressing densities. Flyer barrels between 3.5- and 7.0-mm long and with diameters of 2.5- and 3.8-mm have proved satisfactory. Additional tests indicate strongly that the condition of an acceptor charge diameter smaller than that of the flying plate is important.

8264 (LA—9415-C, pp 261-274) **Deflagration-to-detonation transition in PETN and HMX.** Dinegar, R.H. (Los Alamos National Lab., NM). Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

The deflagration-to-detonation transition (DDT) can be made to occur in both PETN and HMX. The reaction is sensitive to the degree of sub-division and the compactness of the explosive in which the transition takes place. It apparently happens better with explosives of small specific surface loaded at low density. Experiments using thin metal shims between the donor and transition explosive charges indicate an important contribution of shock initiation to the DDT process.

8265 (LA—9415-C, pp 275-292) **LD Detonator: a low-voltage all secondary high-temperature resistant detonator.** Leslie, W.B.; Dietzel, R.W. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

The LD Detonator is a low-voltage detonator, of unique and simple design, that contains only pyrotechnic and secondary explosive materials. The detonator is a DDT (deflagration-to-detonation transition) device. Exploratory experiments have demonstrated that

lmost any explosive can be used including the highest temperature resistant available. A systematic investigation showed that the most critical parameter is the loading density of the explosive; optimum density is approximately half of crystal density. For a particular loading density, some minimum length of explosive column is required for growth to detonation. A minimum amount of confinement is also essential. With an understanding of these essential details, a model detonator containing the explosive HNS was designed and studied. The detonator was fired by a 3.5-A pulse and functioned at -80°C and 210°C. It was capable of initiating high density pellets of HNS. The function time of the model detonator was found to be in the range of 2 to 3.5 ms. The function time of the explosive column (after ignition from the bridgewire) was about 73 μs. Detonators were fabricated with other explosives: PETN, RDX, HMX, HNAB, ABH, BTX, PYX, NONA, ONT, TNN, and TPT. It was shown that these detonators could initiate high-density pellets of the same explosive. The upper temperature limit of the LD design was explored, and it was found that detonators containing NONA, ONT, or TNN could survive and then function at temperature, after being at 300°C to 320°C for 2 hr. The detonator is simple in design, can utilize many different secondary explosives, and can survive high temperatures. Since some minimum length is required for growth to detonation, miniaturization of the detonator is unlikely.

8266 **Explosive double salts and preparation.** Cady, H.H.; Lee, K.Y. (to Dept. of Energy). US Patent Application 345,460. 3 Feb 1982. 26p. Contract W-7405-ENG-36.

A new composition of matter has been discovered which is an explosive addition compound of ammonium nitrate (AN) and diethylenetriamine trinitrate (DETN) in a 50:50 molar ratio. the compound is stable over extended periods of time only at temperatures higher than 46°C, decomposing to a fine-grained eutectic mixture (which is also believed to be new) of AN and DETN at temperatures lower than 46°C. The compound of the invention has an x-ray density of 1.61 g/cm^3, explodes to form essentially only gaseous products, has higher detonation properties (i.e., detonation velocity and pressure) than those of any mechanical mixture having the same density and composition as the compound of the invention, is a quite insensitive explosive material, can be cast at temperatures attainable by high pressure steam, and is prepared from inexpensive ingredients. Methods of preparing the compound and the fine-grained eutectic composition of the invention are given.

4502 Nuclear

REFER ALSO TO CITATION(S) 8149, 8249, 8420, 8423, 8424, 8715, 8716

8267 **(AD-A—114546/5) Introduction to nuclear dust/debris cloud formation. Topical report 7 Nov 79-1 Jul 81.** Rosenblatt, M. (California Research and Technology, Inc., Woodland Hills (USA)). 1 Jul 1981. 48p. NTIS, PC A03/MF A01.

The detonation of a nuclear device on or near the Earth's surface generates a lofted cloud composed of dust and other debris. The objectives of this report are to provide (1) an overview of dust/debris cloud phenomenology and (2) examples of cloud characteristics. Physical phenomenology associated with surface bursts (e.g., crater ejecta) and airbursts (e.g., shock reflections and sweep-up layer formation) are discussed and examples are presented.

8268 **(AD-A—114738/8) Calculation of radiated signals from high-altitude nuclear detonations by use of a three-dimensional distribution of Compton electrons. Interim report.** Crain, C.M. (RAND Corp., Santa Monica, CA (USA)). Mar 1982. 51p. NTIS, PC A04/MF A01.

This Note presents the essential details of a three-dimensional method of calculating the radiated electromagnetic signal that is caused by magnetic deflections of a distribution of Compton electrons produced in the upper atmosphere by prompt gamma radiation from a high-altitude nuclear detonation or a series of detonations. The method differs from that previously developed for such calculations in that the solution is obtained from summing the radiation fields from the individual electrons in a three-dimensional volume instead of combining the individual electron motions to determine a time-and space-dependent current from which the radiation field is evaluated using a one-dimensional approximation to the solution of Maxwell equations. In the Note the effects of the time characteristics of the source gamma output, the effects of atmospheric scattering in reducing the coherent radiation from the Compton electrons, and the effect of residual atmospheric ionization (preionization) in reducing the observer signal amplitude are developed and illustrated numerically. The three-dimensional characteristics of the source are brought out in illustrative numerical examples. These examples give additional physical insight into the source characteristics and demonstrate the importance of scattering and atmospheric ionization, when present, in influencing the EMP amplitude/time characteristics.

8269 **(AD-A—995142/7) Operation Redwing. Project 2.51, neutron-flux measurements. Extracted version. Report for May-Jul 56.** Luke, C.W.; Rigotti, D.L.; Kinch, J.W.; Fullwood, R.; Anderson, D. (Kaman Tempo, Santa Barbara, CA (USA)). 15 May 1981. 67p. NTIS, PC A04/MF A01.

No abstract available.

8270 **(AD-A—995143/5) General report of weapons tests. Ground-motion studies on Operations Ivy and Castle. Extracted version.** Perret, W.R. (Kaman Tempo, Santa Barbara, CA (USA)). 1 Nov 1981. 52p. NTIS, PC A04/MF A01.

No abstract available.

8271 **(AD-A—995144/3) Operation Castle. Report of the Manager Santa Fe Operations. Extracted version.** (Kaman Tempo, Santa Barbara, CA (USA)). 1 Nov 1981. 113p. NTIS, PC A06/MF A01.

No abstract available.

8272 (LA—9415-C, pp 293-308) **Feasibility of a complex-shaped energy-storage capacitor having a dielectric similar to Mylar.** Lagasse, R.R. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

A thermoforming/heat-treatment process analogous to Dupont's process of preparing flat Mylar film has been developed to prepare complex-shaped dielectrigmonstrated with measurements of the 1 kHz dielectric constant from -55 to +70°C, leakage current at 1 kV, and breakdown voltage. This similarity has stimulated a feasibility study on a complex-shaped energy-storage capacitor that could enhance nuclear safety in certain applications by allowing strong links in a firing set to be enclosed with a weak link. In cooperation with Departments 842 and 814 at BKC, four capacitors have been fabricated on aluminum canisters having a diameter of ~ 15 cm, a height of 12 cm, and a tapered wall section. They were covered first with 15 to 50 μf capacitance and 6.5 to 8.5 kV breakdown voltage. Furthermore, by over-laying three dielectric layers with alternating conductive layers, we have shown that the capacitance can be increased to at least 0.12 μf with no sacrifice in breakdown voltage.

8273 (LA—9415-C, pp 309-316) **Electron erosion: a proposed failure mechanism for high-energy density capacitors.** Mauldin, G.H. Sep 1982. NTIS, PC A14/MF A01.

From 6. annual firing systems conference; Los Alamos, NM, USA (17 Nov 1981).

Continued research effort on the perfluorocarbon high energy density capacitor technology has been directed toward a better understanding of the failure mechanism or mechanisms inherent in this technology. A number of varied experiments have been conducted during the past year, all designed to advance this understanding. The results of this experimental effort suggest that a single failure influence is involved. It is hypothesized that this influence is erosion of the dielectric material by electrons stripped off the electrode material and accelerated across the gap between electrodes and dielectric by the fields present. For example, it has been observed that the thickness of the liquid layer between electrodes

and dielectric, as controlled by winding tightness, has a dramatic effect on discharge life. A thick layer of liquid results in a large increase in discharge life. It is proposed that the thicker layer acts as a more effective electron screen between the electrodes and dielectric hence reducing the rate of erosion and attendant wear-out. Other experiments have supported this hypothesis without anomaly. This paper describes the model and presents varied test results in support of this hypothesis.

8274 **Yields of the Hiroshima and Nagasaki explosions.** Malik, J. (Los Alamos National Lab., NM). pp 98-110 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

Estimates of the yields of the Hiroshima and Nagasaki explosions remain rather uncertain. The Fat Man device that exploded over Nagasaki had been tested at Project Trinity and was the explosive for the Operation Crossroads tests. Its yield has been reasonably well established by radiochemical and fireball data, together with calculations, as 22 +- 2 kt. The explosion of the Little Boy device over Hiroshima, however, was the only detonation of this device. Blast effects observed at Hiroshima compared with similar effects at Nagasaki suggest a yield of 12 +- 4 kt, which is based on the Nagasaki yield of 22 kt. A comparison of the similar thermal effects at the two cities suggests a yield of 15 +- 3 kt; old calculations support this value. A reevaluation of the pressure data obtained by gauges in canisters dropped from an accompanying aircraft suggests a yield of 17 +- 4 kt.

4503 Explosion Detection

8275 **(AD-A—114653/9) A technical assessment of seismic yield estimation. Appendix. Part 1.** (Defense Advanced Research Projects Agency, Arlington, VA (USA)). Jan 1981. 304p. NTIS, PC A14/MF A01.

The DARPA report, 'A Technical Assessment of Seismic Yield Estimation,' is a review of the state of current understanding of important technical issues relating to the seismic estimation of the yield of underground nuclear explosions. In preparing this review, contributions were solicited from selected government, university, and industry scientists who responded with summaries of their assessment of the state of knowledge in those areas with which they were most familiar. These contributions are collected in this Appendix.

8276 **(AD-A—114654/7) A technical assessment of seismic yield estimation. Appendix. Part 2.** (Defense Advanced Research Projects Agency, Arlington, VA (USA)). Jan 1981. 198p. NTIS, PC A09/MF A01.

In the context of nuclear explosion seismology, surface wave magnitudes, MS, derived from measurements of Love or Rayleigh waves, have assumed particular importance since they are utilized in two areas, namely: Discrimination - where the discrimination between explosions and earthquakes relies heavily on the contrast in surface wave generation by the two event types. This contrast is normally measured by MS vs body wave magnitude, mb, criteria. Determination of explosion yield using MS. In this paper, the background of surface wave magnitude determination is outlined, followed by discussions of present practice in surface wave measurements at both teleseismic and regional distances. A final section outlines recommended studies related to improving determination of surface wave magnitudes and other, more sophisticated, methods of evaluating long period energy content in the seismic surface wave train.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 7225, 8062, 8352, 8483, 8889

8277 **(DOE/EV/10019—13) Ecological consequences of a CO_2-induced climatic change on forest ecosystems. Volume II, Part 13 of environmental and societal consequences of a possible CO_2-induced climate change.** Johnson, W.C.; Sharpe, D.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Biology; Southern Illinois Univ., Carbondale (USA). Dept. of Geography). Oct 1982. Contract AS01-79EV10019. 36p. NTIS, PC A03/MF A01. Order Number DE83002975.

Discussions centered around four major issues: biogeography, e.g., geographic shifts in species' ranges and in ecosystems, faunal migration patterns; process and ecosystem-level responses e.g., primary and secondary productivity, decomposition rates, food web interactions, diversity; disturbance, e.g., frequency of fire, drought, glaze ice, hurricanes, which affect successional patterns and landscape species composition; and land use, the relationship between man's activities and forest utilization, e.g., forest-farm conversions. Interaction among the four categories is considerable. For example, changes in disturbance patterns and rates can alter regional biomass and diversity. Alternatively, the rate of migration of flora and fauna in response to a changing climate would likely be affected by land use pattern which alters both the number and distribution of safe sites for colonization and the rates of local extinction. Recommendations are made for research in the following areas: population-ecosystem modeling; climate-ecosystem interrelationships; spatio-geographic modeling; organismic tolerance - genetic heterogeneity; keystone and indicator species; spatial resolution of models; land use; and biological monitoring.

8278 **(DOE/EV/10235—1) Climate impact assessment. Final report.** Berkofsky, L. (Maryland Univ., College Park (USA). Dept. of Meteorology). Oct 1979. Contract AS05-79EV10235. 94p. NTIS (US Sales Only).

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Assessments are presented on the impact of monthly and seasonal climatic fluctuations on energy consumption and production, including fuel extraction, processing, transportation, storage and utilization; and socioeconomic consequences are identified. The information needs for such analyses are discussed along with the state of the art in weather forecasting for varying periods of time and weather extremes. (PBS)

8279 (KFK-AFR—003, pp 29-30) **New method of water analysis using NAA: Detection of trace elements without enrichment in high-purity water, river water, and sewage water.** Kim, J.I.; Lux, D. May 1981. (In German). Dep. NTIS (US Sales Only).

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8280 (KFK-AFR—003, pp 27) **Investigation of exchange processes of trace elements in airborne dust with the aid of radionuclide techniques including microautoradiography.** Glueck, C.; Calmano, W.; Lieser, K.H. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8281 (NP—3900217) **SODAR measurements of inversions above the Rhine valley (Cologne and environment).** Dohrn, R.; Raschke, E.; Bujnoch, A.; Warmbier, G. (Koeln Univ. (Germany, F.R.). Inst. fuer Geophysik und Meteorologie). 1981. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83900217.

During the time period of June 1978 to June 1980 the inversion heights have been measured continously with two SODARs of which one is located near the centre of Cologne and the other about 12 km northwest of it (rural environment). Verification meas-

urements have been made in some cases with a balloon borne tethered sonde, and a pattern recognition method has been developed for automatic analysis of digitized SODAR records. In this paper are also presented statistical analysis of the annual and diurnal variation of probability of inversion occurence and height. Significant differences occure for the low level inversion structures over both stations while upper level inversions show large similarities. The inversion height depends to some degree also on the surface geostrophic wind speed.

8282 **Breakup of temperature inversions in deep mountain valleys. Part I. Observations.** Whiteman, C.D. (Pacific Northwest Lab., Richland, WA). *Journal of Applied Meteorology;* **21**: No. 3, 270-289(Mar 1982).

The breakup of temperature inversions in the deep mountain valleys of western Colorado has been studied by means of tethered balloon observations of wind and temperature structure on clear weather days in different seasons. Vertical potential temperature structure profiles evolve following one of three patterns. Two of the patterns are special cases of the third pattern, in which inversions are destroyed by two continuous processes - upward growth of a convective boundary layer (CBL) into the base of the valley inversion, and descent of the inversion top. The three idealized patterns are described and 21 case studies of inversion breakup following the patterns are summarized. Inversion breakup begins at sunrise and is generally completed in 3-1/2 to 5 h, unless the valley is snow covered or the ground is wet. Warming of the inversion layer is consistent with subsidence heating. An hypothesis is offered to explain the observations, stressing the role of the sensible heat flux in causing the CBL to grow and an upslope flow to develop over the sidewalls. As mass is removed from the base of the inversion layer in the upslope flows, the inversion sinks and warms.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 6750, 6756, 6837, 6838, 6975, 6976, 6977, 6980, 7262, 7269, 8064, 8073, 8305, 8396, 8436

8283 **(AD-A—114661/2) Chemical reactions and molecular aggregation in cryogenic whole air sample matrices. Final report 1 Mar 80-30 Sep 81.** Calo, J.M.; Fezza, R.J.; Ryan, G.F. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). Jan 1982. 110p. NTIS, PC A06/MF A01.

Chemical reactions and molecular aggregation phenomena in cryogenic condensates associated with in-situ cryogenic whole air sampling of stratospheric species are examined. Results for two types of studies are reported. In the first type, the gas phase composition resulting from thermal desorption of pure and mixed condensates collected on the cold end of a mechanical, helium-cycle, cryogenic refrigerator is determined with mass spectrometry and NOx chemiluminescence (when possible). This technique was applied to studies of the reactions of nitric oxide and ozone upon thermal desorption. The most salient results were: (1) disproportionation of nitric oxide to nitrogen dioxide and nitrogen during desorption of pure nitric oxide condensate at levels exceeding 50%; (2) significant recombination of ozone upon flash desorption; and (3) oxidation of nitric oxide to nitrogen dioxide by ozone upon desorption of nitric oxide/ozone condensates. The second technique involves the direct observation of species behavior in the cryogenic condensate upon warming with infrared spectrophotometry.

8284 **(AD-A—114906/1) Federal Aviation Administration: High Altitude Pollution Program, third biennial report prepared in accordance with the Stratospheric Ozone Protection Provision, section 153(g), of the Clean Air Act amendments of 1977. Report for Jan 80-Dec 81.** (Federal Aviation Administration, Washington, DC (USA). Office of Environment and Energy). Dec 1981. 43p. NTIS, PC A03/MF A01.

The impact of high altitude aviation on stratospheric ozone is now believed to be a decrease in total columnar ozone for flights above 15 km (about 49,000 feet). The model calculations also show that the current subsonic fleet (and the fleet foreseeable to 1990) will result in a net ozone increase of about 1 percent, considering normal flight altitudes. Whatever the net change in total column ozone, increases or depletions will occur at different altitudes. These are expected to have subtle influences on atmospheric circulation, the effects of which are only beginning to be understood. As a formal program, the High Altitude Pollution Program will be terminated in 1982 with the issuance of a final report. The FAA will continue to maintain and update, as appropriate, its capability to make quantitative assessments of the environmental effects of cruise-altitude emissions, and will monitor and assist, as possible, other research programs, both here and abroad.

8285 **(AD-A—114997/0) An evaluation of occupational exposure to hydrazine (h-70) during routine maintenance tasks associated with the F-16 Emergency Power Unit. Technical report.** Christensen, W.D. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Mar 1978. 35p. NTIS, PC A03/MF A01.

During the week of 23 to 27 January 1978 , a survey team from the USAF Occupational and Environmental Health Laboratory conducted an analysis of maintenance tasks associated with the F-16 Emergency Power Unit (EPU). This analysis involved definition of tasks for both aircraft and hydrazine fill stand activities and included the collection of personal and short period air samples to define airborne exposure to hydrazine during these tasks. The tasks which were identified include: nitrogen depressurization, catalyst purge, poppet valve replacement and the entire refilling procedure. Measurements indicate compliance with a Time Weighted Average value of 0.1 ppm hydrazine, however, potential peak exposures which range as high as 5 to 8 ppm do occur during some tasks. A technician would be unaware of many such exposures since concentrations below the odor threshold of 3 to 5 ppm give no warning but are at least an order of magnitude above acceptable occupational exposure limits. Recommendations are provided for the elimination of these sources of potential peak exposure and for the use of personal protective equipment during specific tasks.

8286 **(BNL—26371) Atmospheric production and transport of sulfur oxides in the United States.** Meyers, R.E.; Cederwall, R.T.; Kleinman, L.I.; Schwartz, S.E. (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract AC02-76CH00016. 50p. NTIS, PC A03/MF A01. Order Number DE83004293.

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This report summarizes extensive analyses of air quality that examine the impact of the emission and subsequent long-range transport of coal-generated sulfur pollutants from major coal-burning utility and industrial installations. Air quality impacts based upon the National Energy Plan were projected for the years 1985 and 1990, using the Brookhaven National Laboratory (BNL) air quality model. Comparisons were made with recent air quality data that are also used to check the long-range atmospheric transport and transformation model.

8287 (CONF-8105173—, pp 8p, Paper 47) **Contributions of clean air plans to the realization of projected large hard coal fuelled power plants in areas of industrial concentration.** Dreyhaupt, F.J.; Schmitt, O.A. 1981. NTIS (US Sales Only), PC A99/MF A01.

From 3. seminar on the desulphurization of fuels and combustion gases; Salzburg, Austria (18 May 1981).

For solving the air pollution problem in areas of industrial concentration a concept has been developed over the past years in the Federal Republic of Germany backed by laws based on the air quality control programme. The clean air plan aims at analyzing air quality in an entire region (so-called air quality control regions, for example polluted areas in Northrhine-Westphalia) and, based on the results of this analysis, at developing a programme to improve air quality over a medium-range time scale which is to be realized according to priorities. The nucleus of the clean air plan is the list of measures. The latest clean air plan, issued in December 1980 for the central Ruhr Area, is taken as an example to show how the industrial emission sources are identified which contribute considerably to atmospheric emission in excess of the existing emission standards and what emission reduction is requested of them. This reduction not only aims at eliminating the emission in excess of emission standards but also at creating a safety margin which is a prerequisite to granting licenses to new, hard coal fired power plants.

8288 **(DOE/CS/20291—T1) Trace-chemical characterization of pollutants occurring in the production of landfill gas from the shoreline regional park sanitary landfill, Mountain View, California.** Flynn, N.W.; Guttman, M.; Hahn, J.; Payne, J.R. (Science Applications, Inc., La Jolla, CA (USA)). Apr 1981. Contract FG01-79CS20291. 105p. NTIS (US Sales Only). Order Number DE83002749.

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A summary is presented of the results of sampling and analysis of ambient and process gas streams, and liquid and solid samples taken at different locations from the Pacific Gas and Electric Company Landfill Gas Recovery Plant in Mountain View, California. The purpose of this study is to identify environmental pollutants and characterize the trace chemistry of landfill gas recovered from the Mountain View Sanitary (Class II) Landfill. Gaseous samples, liquid condensate, and other plant products were analyzed for their trace chemical constituents, and the results indicate that certain organic and inorganic pollutants inherent to the landfill are emitted into the ambient environment and also become involved in the methane recovery process. Incorporation of condensate traps, molecular sieve, and charcoal filtration was found to significantly reduce both the organic and inorganic component burdens in the product gas. The environmental significances of the landfill gas recovery to the surrounding area and to worker safety are presented.

8289 **(DOE/EV/10019—10) Effects of climate change on agricultural-plant pests. Volume II, Part 10 of environmental and societal consequences of a possible CO_2-induced climate change.** Haynes, D.L. (Michigan State Univ., East Lansing (USA). Dept. of Entomology). Oct 1982. Contract AS01-79EV10019. 39p. NTIS, PC A03/MF A01. Order Number DE83002888.

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Plant pests and their community of biotic cohorts respond to climatic changes, whether temporal aberrations or long term shifts. How they respond depends on the magnitude of the change and the ability of the species to tolerate or adapt to the new environment. Scientists see several climatological scenarios concerning the increase of atmospheric CO_2 and ambient temperature. Those who foresee a slow incremental raising of temperatures base their predictions mainly on the available empirical evidence and the notion that long term weather is basically a cyclical phenomena that continually adjusts and readjusts through time. The other scenario interprets the available empirical data as a gradual buildup that pushes the climatic picture towards a threshold or a trigger point that, once arrived at, is irreversible and dramatic. This paper explores the possible climatic scenarios as they relate to the ecological principles that affect pest abundance and the distribution and impact on domestic and international agriculture.

8290 **(Juel—1776) Atmospheric exposure from toxic metals in the Federal Republic of Germany.** Schladot, J.D.; Nuernberg, H.W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie). Apr 1982. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750741.

Based on the specific emission factors for various pollution sources, a calculation of the emission of toxic metals is presented, which, in spite of scarce data for lead, cadmium and zinc, is used to compute a preliminary balance between emission and deposition. Since deposition was found to be regularly higher than could be expected from emission data, the existence of contributions from external pollution sources outside the territory can be presumed. At this moment it is, however, not possible to give safe statements on the real nature of the difference between emission and deposition which might be partly caused also by uncertainties of data.

8291 **(KFK—3246) Comparative studies on subcellular organelles and their marker enzymes in selected marine animal species and in the rat.** Patel, S.; Balani, M.C.; Patel, B.; Winter, R.; Seidel, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Nov 1981. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750438.

The concentration of several marker enzymes for subcellular organelles has been determined in some marine animal species, which specifically accumulate heavy metals or radionuclides. The dependence of the enzyme activity on the incubation conditions was tested as well as the integrity of the lysosomes after cell homogenization. In several cases, significant differences in the enzyme concentrations between the animal species were observed. The data indicate subcellular studies of the heavy metal accumulation in marine invertebrates require more sophisticated methods for the preservation of the lysosomes, which seem to be much more fragile than in mammalien systems. In addition, several of the marker enzymes used for mammalian organelles appear to be unsuitable for marine invertebrates.

8292 **(KFK—3285) Carbon cycle.** Jaeger, J.; Halbritter, G.; Neumann-Hauf, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse). May 1982. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750962.

This report contains a review of literature on the subjects of the carbon cycle, the increase of the atmospheric CO_2 concentration and the possible impacts of an increased CO_2 concentration on the climate. In addition to this survey, the report discusses the questions that are still open and the resulting research needs. During the last twenty years a continual increase of the atmospheric carbon dioxide concentration by about 1-2 ppm per years has been observed. In 1958 the concentration was 315 ppm and this increased to 336 ppm in 1978. A rough estimate shows that the increase of the atmospheric carbon dioxide concentration is about half of the amount of carbon dioxide added to the atmosphere by the combustion of fossil fuels. Two possible sinks for the CO_2 released into the atmosphere are known: the ocean and the biota. The role of the biota is, however, unclear, since it can act both as a sink and as a source. Most models of the carbon cycle are one-dimensional and cannot be used for accurate predictions. Calculations with climate models have shown that an increased atmospheric CO_2 concentration leads to a warming of the earth's surface and lower atmosphere. Calculations show that a doubling of the atmospheric CO_2-concentration would lead to a net heating of the lower atmosphere and earth's surface by a global average of about 4 W m^{-2}. Greater uncertainties arise in estimating the change in surface temperature resulting from this change in heating rate. It is estimated that the global average annual surface temperature would change between 1.5 and 4.5 K. There are, however, latitudinal and seasonal variations of the impact of increased CO_2 concentration. Other meteorological variables (e.g. precipitation, wind speed etc.) would also be changed. It appears that the impacts of the other products of fossil fuel combustion are unlikely to counteract the impacts of CO_2 on the climate.

8293 **(LBL—15062) Comparative study of NO measurement in methane/air flames.** Cuellar, E.; Brown, N.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1982. Contract AC03-76SF00098. 36p. (CONF-821035—8). NTIS, PC A03/MF A01. Order Number DE83002229.

From Combustion Insitute symposium on western states section; Livermore, CA, USA (11 Oct 1982).

A comparative study of nitric oxide measured in the post-combustion environment of an atmospheric premixed CH_4/air stoichiometric flat flame was conducted. An uncooled quartz microprobe was used for sample extraction, and analysis was accomplished by a chemiluminescent gas analyzer modified to reduce quenching and viscosity corrections. The in-situ optical technique employed is called tunable atomic line molecular spectroscopy (TALSM), and is based on the splitting and polarization of atomic emission lines induced by an external magnetic field. Concentrations of NO were determined by doping the burner with known amounts of NO. At NO doping levels near 1500 ppM, the ratio NO/sub optical//NO/sub probe/ = 1.3 was in agreement with that reported by others. The high sensitivity of the TALMS technique permitted measurement in the thermal NO range (NO<100 ppM). Optical measurements of thermal NO were found to be approximately three times larger than the corresponding probe measurements.

8294 **(PB—82-208646) Critical evaluation and comparison of measurement methods for nitrogenous compounds in the atmosphere. Final report.** Grosjean, D. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Jan 1982. 125p. NTIS, PC A06/MF A01.

This report describes the method and results of an intensive field study of atmospheric nitrogenous pollutants conducted in Claremont, California, a Los Angeles smog receptor site, during selected September and October 1980 photochemical episodes. Parameters measured included nitric oxide and nitrogen dioxide, peroxyacetylnitrate, and refined particulate nitrate and nitric acid. In addition, a limited number of refined particulate samples collected on quartz filters were analyzed for sulfate and for total carbon. All sampling and monitoring instruments were calibrated on-site following Environmental Research and Technology's Standard Operating Procedures. Laboratory quality assurance protocols included appropriate calibrations, analysis of blank and field control filters, analysis of EPA audit samples, and replicate analyses. Sampling control experiments included a number of parallel collections on Teflon filters.

8295 **(PB—82-214297) Development of air sampling and analytical methods for toxic chlorinated organic compounds: research report for monochloroacetic acid.** Dillon, H.K.; Mason, D.W.; Boyd, K.W. (Southern Research Inst., Birmingham, AL (USA)). Sep 1980. 75p. NTIS, PC A04/MF A01.

Methods for determining hexachlorobutadiene, hexachlorocyclopentadiene, 1,2-dichloropropane, monochloroacetic-acid, pentachloroethane and p-chlorophenol in workplace air were developed. For each compounds an analytical method was devised based on selection and calibration of the method; determination of desorption efficiencies of the compound from candidate solid sorbents by solvent extraction; construction and evaluation of an analytic test atmosphere generator and sampling system; determination of the capacities of candidate sorbents for the compound; selection of the sorbent; determination of the stability of the compound when collected from air with the chosen sorbent and determination of the accuracy and precision of the analytical procedure and of the total sampling and analytical method. Each method was tested and modified until the results were considered valid. The author recommends that the effort required per compound, the cost effectiveness of experimental design, field testing of the developed method, and usefulness of research reports be considered for future methods development.

8296 **(PB—82-224965) Laboratory evaluation of nonmethane organic carbon determination in ambient air by cryogenic reconcentration andflame ionization detection. Final report.** Jayanty, R.K.M.; Blackard, A.; McElroy, F.F.; McClenny, W.A. (Research Triangle Inst., Research Triangle Park, NC (USA)). Mar 1982. 89p. NTIS, PC A05/MF A01.

The results of this study demonstrate the feasibility of a technique for analyzing samples of ambient air for gaseous nonmethane organic compounds (NMOC) using a cryogenic trap to both preconcentrate and separate NMOC from methane (CH4). The NMOC is subsequently measured by warming the trap to release the NMOC and channeling the concentrated sample of NMOC into a modified commercial flame ionization detector.

8297 **(PB—82-224973) Environmental assessment of combustion modification controls for stationary internal combustion engines. Final report Sep 78-Jul 79.** Lips, H.I.; Gotterba, J.A.; Lim, K.J.; Waterland, L.R.; Bowen, J.S. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Jul 1981. 139p. NTIS, PC A07/MF A01.

The report gives results of an environmental assessment of combustion modification techniques for stationary internal combustion engines, with respect to NOx control reduction effectiveness, operational impact, thermal efficiency impact, capital and annualized operating costs, and effects on emissions of pollutants other than NOx.

8298 **(PNL-SA—10621) Predicting indoor air pollution levels.** Parker, G.B.; Droppo, J.G.; Owczarski, P.C. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1982. Contract AC06-76RL01830. 11p. (CONF-821131—1). NTIS, PC A02/MF A01. Order Number DE83003470.

From APCA Pacific Northwest International section annual meeting; Vancouver,B.C., Canada (15 Nov 1982).

This paper describes methods of predicting concentration levels of indoor air pollution in a variety of residences by using residence air-infiltration rates, residence volumes, and source terms, and by making assumptions about occupant lifestyle and pollutant distribution. The range of the maximum to minimum concentration, as well as a representative value, of each pollutant present in a residence can be predicted. The predicted values vary for some pollutants by up to three orders of magnitude. The methods can be used for predicting concentration levels in residences with and without retrofitted air-infiltration reduction measures, which are means of making the home more energy efficient. Concentration levels are predicted so that the risk of health effects from installing air-infiltration reduction measures can be assessed.

8299 **The effects of acid rain on forest nutrient status.** Johnson, D.W. (Oak Ridge National Lab., TN); Turner, J.; Kelly, J.M. *Water Resources Research;* **18**: No. 2, 449-461(Jun 1982). Contract W-7405-ENG-26.

The effects of acidic atmospheric inputs on forest nutrient status must be assessed within the context of natural, internal acid production by carbonic and organic acids as well as the nutrient inputs and drains by management practices such as harvesting, fire, and fertilization. Soil acidification will occur only if the often substantial buffering capacity of the soil in question is exceeded by acid inputs and if cation weathering from primary minerals is insufficient to offset cation losses by leaching. Such circumstances are rare but certainly could occur given sufficiently large acid inputs on poorly buffered soils. Soils most sensitive to change are thought to be those of moderately acid pH and low cation exchange capacity. Neither very acid soils nor neutral, highly buffered soils are sensitive to acidification by acid rain. Given extremely high acid inputs, acid rain can cause temporary increases in nitrogen mineralization and nitrification as well as Al mobilization in soils. While temporary increases in N availability can cause increased forest growth in N-deficient forests, increased Al availability can cause toxic reactions in tree roots. Given sufficiently high inputs on sensitive sites, negative effects of acid rain must occur, as is true of inputs of any substance, including H_2O. Acid rain inputs of sufficient magnitude to cause acute effects, such as growth increase due to N mobilization or growth decrease due to Al mobilization, are apparently very rare under ambient field conditions. Long-term effects on forest nutrient status can be either beneficial or adverse, depending on site nutrient status, silvicultural practices, and amount of atmospheric inputs. (JMT)

8300 **A model for the dry deposition of particles to natural water surfaces.** Williams, R.M. (Argonne National Lab., IL). *Atmospheric Environment;* **16**: No. 8, 1933-1938(1982).

More realistic estimates of the deposition velocity, for aerosol particle deposition on natural water surfaces, are obtained by modifying earlier resistance models to include the effects of wave breaking and spray formation in high winds and particle growth in the humid regions near the air/water interface. Both processes act to enhance deposition by shunting the high transfer resistance to a smooth water surface. The result is to drastically reduce the dependence of deposition velocity on particle size; however, the deposition velocity is still substantially below the limiting value set by atmospheric turbulence.

8301 **Comparison of numerical models for calculating dispersion from accidental releases of pollutants.** Pepper, D.W. (Savannah River Lab., Aiken, SC); Cooper, R.E.; Baker, A.J. *Science of the Total Environment;* **23**: 127-140(1982). Contract AC09-76SR00001.

A modular, data-based system approach has been developed to facilitate computational simulation of multi-dimensional pollutant dispersion in atmospheric, steam, estuary, and groundwater applications. This system is used to assess effects of accidental releases of

pollutants to the environment. Model sophistication ranges from simple statistical to complex three-dimensional numerical methods. The system used specifies desired degree of model sophistication from a terminal. The model used depends on the particular type of problem being solved, and on a basis of merit related to computer cost. The results of prediction for several model problems are presented.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 7575

8302 **(CONF-810153—3) Radon in atmospheric studies: a review.** Wilkening, M. (New Mexico Inst. of Mining and Technology, Socorro (USA)). 1981. Contract AS04-78ET05369. 10p. NTIS, PC A02/MF A01. Order Number DE83003345.

From 2. special symposium on natural radiation environment; Bombay, India (19 Jan 1981).

The distribution of the isotopes of radon in space and time, their physical characteristics, and their behavior in the dynamics of the atmosphere have presented challenges for many decades. ^{220}Rn, ^{222}Rn and their daughters furnish a unique set of tracers for the study of transport and mixing processes in the atmosphere. Appropriate applications of turbulent diffusion theory yield general agreement with measured profiles. Diurnal and seasonal variations follow patterns set by consideration of atmospheric stability. ^{222}Rn has been used successfully in recent studies of nocturnal drainage winds and cumulus convection. Good results have been obtained using ^{222}Rn and its long-lived ^{210}Pb daughter as tracers in the study of continent-to-ocean and ocean-to-continent air mass trajectories, ^{220}Rn (thoron) because of its short half-life of only 55 seconds has been used to measure turbulent diffusion within the first few meters of the earth's surface and to study the influence of meteorological variables on the rate of exhalation from the ground. Radon daughters attach readily to atmospheric particulate matter which makes it possible to study these aerosols with respect to size spectra, attachment characteristics, removal by gravitation and precipitation, and residence times in the troposphere. The importance of ionization by radon and its daughters in the lower atmosphere and its effect on atmospheric electrical parameters is well known. Knowledge of the mobility and other characteristics of radon daughter ions has led to applications in the study of atmospheric electrical environments under fair weather and thunderstorm conditions and in the formation of condensation nuclei. The availability of increasingly sophisticated analytical tools and atmospheric measurement systems can be expected to add much to our understanding of radon and its daughters as trace components of the atmospheric environment in the years ahead.

8303 **(DOE/EV/13573—32) Fate of nuclides in natural-water systems. Annual progress report, October 1, 1981-March 31, 1983.** Turekian, K.K. (Yale Univ., New Haven, CT (USA). Dept. of Geology and Geophysics). 30 Nov 1982. Contract AC02-76EV13573. 8p. (COO—3573-32). NTIS, PC A10/MF A01. Order Number DE83003060.

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The atmospheric fluxes of ^{210}Pb and ^{7}Be at New Haven, CT, and Bermuda were determined and compared with model fluxes. The reliability of these radionuclides as tracers for other chemical species injected into the atmosphere by human activity was therefore tested. The distribution of ^{10}Be in soil profiles was studied. The initial aim was to use the standing crop of ^{10}Be in the soil to obtain an exposure age of the surface. Dated surfaces (i.e. raised coastal terraces, dated volcanic flows, etc) showed that ^{10}Be does not totally accumulate in the soils but is mobilized. The mean residence time appears to be about 20,000 years. In a related study a number of the members of the ^{238}U and ^{232}Th decay series nuclides were measured in the major ground water aquifer types in Connecticut. Using ^{222}Rn as a flux indicator it was possible to determine the adsorption and desorption coefficients, distribution coefficients and retardation factors of Ra, Pb, and Th in these aquifers. The study of the transport of nuclides by the Connecticut River and the study of the Amazon River plume were completed. Also completed was one of the most intensive studies of the behavior of natural radionuclides and plutonium in an estuarine system, the Long Island Sound, by analyzing two nearshore sites (SACHEM and FOAM) to complement the deep water sites (NWC and DEEP). The chronologies of accumulation, bioturbation, human disturbance and physical change were established for these varied environments.

8304 **(SRD-R—218) PLURAD: a computer program to predict the backgound for actinide-in-air monitoring in buildings from radon isotopes.** Meggitt, G.C.; Walker, B.C. (UKAEA Safety and Reliability Directorate, Culcheth). Dec 1981. 20p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth Warrington, WA3 4NE, England.

Airborne plutonium contamination detection by alpha-particle spectrometry has to be achieved against a background from the daughters of the two naturally occurring radon isotopes Rn-220 and Rn-222. This background can be modified in a number of ways by building and ventilation system design. The report describes a computer program, PLURAD, that models mathematically the major physical processes determining this background. With the provision of input data specific to particular locations and designs it permits the investigation of the reductions in background which can be achieved by surface coating, ventilation rate increase and filtration of inlet air.

5006 Regulations

8305 **(EPA—450/3-80-037b) Industrial surface coating, large appliances: background information for promulgated standards.** Goodwin, D.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Oct 1982. 51p. NTIS.

On December 24, 1980, the US Environmental Protection Agency (EPA) proposed a standard of performance for appliance surface coating operations (45 FR 85085) under authority of Section 111 of the Clean Air Act. The Federal Register notice requested public comments on the proposal. There were 19 commenters, most of whom were appliance manufacturers, and the others were coating manufacturers, trade associations, and state and federal government offices. Three presentations were made at the public hearing on January 28, 1981. Comments submitted and their responses are summarized. The bases for revisions made to the standard between proposal and promulgation are described in this document. Revised estimates for annual emissions of volatile organic compounds (VOC) are tabulated.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 6839

8306 **Chaotic models as representations of ecological systems.** O'Neill, R.V.; Gardner, R.H.; Weller, D.E. (Oak Ridge National Lab., TN). *American Naturalist;* **120**: No. 2, 259-263(Aug 1982). Contract W-7405-ENG-26.

Interest has been shown in the dynamics of simple models whose predictions can be chaotic, that is, not tending toward an equilibrium point or limit cycle. In addition to studies of the models, attempts have also been made to find populations exhibiting chaotic oscillations, to assess the ecological relevance of chaotic models, and to formulate evolutionary explanations for the apparent failure to observe chaos in natural populations. Many of these studies have analyzed the equation N/sub t+1/ = N/sub t/exp[r(1 - N/sub t//K)] where N/sub t/ is the population size at time t, r is the intrinsic growth rate, and K is the carrying capacity. In this study, we scale the population by its equilibrium value (i.e., X/sub t/ = N/sub t//K) to obtain the normalized equation X/sub t+1/ = X/sub t/exp[r(1 - X/sub t/)]. Dynamic behavior of this equation is determined by the value of r. If r > 2.69, model behavior is chaotic and the solution may oscillate aperiodically. We included ecological constraints by selecting r at each time interval from a uniform distribution with expected value r/sub m/ and upper and

lower limits of r/sub m/.(1 +- r./sub %/). Extinction was assumed to occur whenever X/sub t/ was less than 0.001.

8307 **Mark and removal field procedure for estimating population abundance.** Skalski, J.R. (Pacific Northwest Lab., Richland, WA); Robson, D.S. *Journal of Wildlife Management;* **46**: No. 3, 741-751(Jul 1982).

A census design is presented that yields data for estimating animal abundance in closed populations using mark-recapture and constant removal techniques. Tests of goodness-of-fit for the multinomial removal model and homogeneity of capture probabilities for marked and unmarked animals are presented. When assumptions are valid, a 3rd abundance estimator, the mark-removal method, may be used, which generally possesses smaller sampling variance. Computer simulations estimate the relative efficiency of the alternative estimators when valid. Capture data are used to illustrate that agreement among diverse abundance estimators is not necessarily presumptive evidence of model validity.

8308 **Testing for competition: a critique of De Vita's use of the broken-stick model.** Shelly, T.E. (Univ. of California, Los Angeles); Christensen, S.W. *American Naturalist;* **119**: No. 3, 435-436(Mar 1982). Contract W-7405-ENG-26.

A comment on the article by J. De Vita, "Niche separation and the broken-stick model" (American Naturalist 114, 1979, pp. 171-178) is presented. The author contends that De Vita failed to provide an exact, operational criterion for assessing goodness-of-fit between observed and predicted broken-stick values, and that adherence to the 2 SD criterion for all interval lengths will result in the classification of random sets as nonrandom. The author contends this problem would significantly limit the usefulness of De Vita's proposed test of ecological competition. (JMT)

8309 **Behavior of REE in geological and biological systems.** Laul, J.C.; Weimer, W.C. (Pacific Northwest Lab., Richland, WA). pp 531-535 of Rare earths in modern science and technology. Vol. 3. McCarthy; Silber; Rhyne (eds.). New York, NY; Plenum Publishing Corp. (1982). Contract AC06-76RL01830.

The rare earth elements (REE) abundances when normalized to primordial (chondritic) abundances behave as a smooth function of the REE ionic radii in both the geological and biological systems. The REE are hardly fractionated chemically through various states of their transformation from soil-soil extract-plant-geological systems.

8310 **Calibrating an index by using removal data.** Eberhardt, L.L. (Pacific Northwest Lab., Richland, WA). *Journal of Wildlife Management;* **46**: No. 3, 734-740(1982). Contract AC06-76RL01830.

A method is presented for estimating population size from index data collected before and after removal of a known number of individuals. An approximate variance estimate is given and used to delineate circumstances where the method may be useful. Confidence limits are obtained from Fieller's method and illustrated with data from feral horse (Equus caballus) herds. A comparison with the use of marking is provided.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 8277, 8456

8311 **Effects of acid rain on forest nutrient status.** Johnson, D.W.; Turner, J.; Kelly, J.M. (Oak Ridge Natl Lab, TN, USA). *Water Resources Research;* **18**: No. 3, 449-461(Jun 1982).

The paper presents an extensive literature review that deals with the assessment of the effects of acidic atmospheric inputs on forest nutrient status within the context of natural, internal acid production by carbonic and organic acids as well as the nutrient inputs and drains by management practices such as harvesting, fire and fertilization. 123 refs.

8312 **Heavy metal contents of plants at six different soils as affected by high doses of sewage sludge.** Horak, O. Vienna, Austria; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (1981). 11p. (In German).

From 92. congress of the Verband Deutscher Landwirtschaftlicher Unternehmungs- und Forschungsanstalten; Braunschweig, Germany, F.R. (15 - 20 Sep 1980).

A pot experiment was carried out in a greenhouse with corn, rape and pea on different soils with pH from 4.5 to 7.6. The soils were treated with mineral fertilizer or with a high dose of sewage sludge, corresponding to 160 t of dry matter per hectare. The contents of Fe, Mn, Zn, Cu, Mo, Co, Pb, Cd, Ni and Cr were determined in the plants after a growing period of eight weeks. Generally, the application of sludge caused a considerable increase in the Zn content of the plants. Also the content of Cu increased slightly in all crops receiving the sludge, but the Mo-level was raised distinctly only in the tissues of rape. The contents of Mn, Cd and Ni partly decreased, especially on acid soils, which was caused by the alkaline effect of the sludge. The contents of Fe increased slightly, those of Co, Pb and Cr were not affected by the sludge application.

8313 **Two-mirror multipass absorption cell.** Altmann, J.; Baumgart, R.; Weitkamp, C. Geesthacht-Tesperhude, Germany; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1981). 5p. (GKSS—81/E/26).

A multipass cell for absorption measurements with laser light is described. The number of passes is adjusted by variation of the distance of two parallel concave mirrors. The position and direction of the exit beam do not change when the path length is varied. A cell of 1-m length was used for infrared absorption measurements with an effective path length between 3 and 150 m.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 7029, 7033, 7061, 7062, 7063, 8303, 8349, 8352, 8406

8314 **(DOE/DP/00539—045) Animal investigation program 1980 annual report: Nevada Test Site and vicinity.** Smith, D.D.; Giles, K.R.; Bernhardt, D.E. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Aug 1982. Contract AI08-76DP00539. 63p. (EPA—600/3-82-077). NTIS, PC A04/MF A01. Order Number DE83003354.

Data are presented from the radioanalyses of tissues collected from cattle, mule deer, desert bighorn sheep, rabbits, and a horse that resided on or near the Nevada Test Site during 1980. Routine and special activities of the Animal Investigation Program are also discussed. Other than the naturally occurring ^{40}K, gamma-emitting radionuclides were detected infrequently. ^{131}I was found in the thyroid of a deer 3 weeks after a nuclear test by the People's Republic of China. Concentrations of ^{90}Sr in bones from deer, cattle, and desert bighorn sheep were similar to those of recent years. Plutonium levels in all tissues from all species showed little variation from those levels in samples collected in recent years. Radionuclide concentrations were generally higher in the tissues of animals residing in Area 15 than in similar animals collected from other Nevada Test Site areas. Surface soil samples from the Area 15 farm contained ^{238}Pu and ^{239}Pu in nanocurie per kilogram concentrations. Hypothetical annual dose estimates to man were calculated on the basis of the daily consumption of 0.5 kilogram of liver or muscle from animals that contained peak radionuclide levels. The highest postulated dose was 0.4 millirems to whole body for ^{137}Cs in muscle obtained from cattle. This dose is about 0.1 percent of the 500 millirems per year radiation protection guide for individuals in the general population. All other postulated doses for consumption of tissues containing other radionuclides were less than 0.1 percent of the standard.

8315 **(DOE/EV/02283—3) Response of a forest ecotone to ionizing radiation. Progress report, October 15, 1981-April 14, 1983.** Murphy, P.G.; Sharitz, R.R. (Michigan State Univ., East Lansing (USA); Savannah River Ecology Lab., Aiken, SC (USA)). Nov 1982. Contract AC02-76EV02283. 24p. NTIS, PC A02/MF A01. Order Number DE83003356.

Compositional and structural characteristics of three forest types, including aspen dominated, maple-birch dominated, and an intervening ecotone (midecotone), were studied before and after irradiation in northern Wisconsin. In all three areas, the density of seedlings at 10 m was greatly reduced within a year following the 1972 radiation event. Woody plants of tree stature were eliminated at 10 m in all three areas within two years of irradiation but by 1982 only the aspen area lacked plants in this size class. The low densities of young trees in the other two areas at 10 m were of successional species rather than the original species killed by radiation. In 1981 total leaf litter production was 42 and 61% below 1971 preirradiation levels at 10 m in the aspen and maple-birch areas, respectively. But at 10 m in the midecotone, it had increased, relative to 1971, by 23%. The ratio of shrub to tree leaf litter continues to decline as the heavily irradiated zone of all three areas continues to be recolonized by tree species and the canopy at 20 m continues to fill out. Our present studies emphasize the rate at which the three areas continue to be recolonized and the composition of the recolonizing flora, relative to the preirradiation forest. Influences of the successional shrub species within 10 m are of particular interest and are also under study.

8316 (KFK—3282) Dose exposure of the environmental population caused by natural Ra-226 and Pb-210 and released from uraniferous heaps. Schuettelkopf, H.; Kiefer, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Mar 1982. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750680.

The concentrations of Ra-226 and Pb-210 in samples of air, soil, surface water, and foods from Wittichen agree well with the average environmental concentrations. Higher values are found in soil samples from old heaps, in surface waters being in contact with these heaps and in grass and mushrooms grown on such heaps. On the supposition that only locally produced foods are used for annual intake, an annual activity intake of 925 pCi Ra-226 and 2 772 pCi Pb-210 is determined. These annual intakes are higher by a factor of 2.1 compared with the maximum permissible intakes given by the Radiation Protection Ordinance. The transfer factors determined in other parts of the Black Forest are in accordance with these values. The Pb-210 concentrations in grass and leafy vegetables are pretty high; the contamination of this kind of samples is caused by the deposition of Pb-210 from ground level air. Using Pb-210 concentrations in air and plants, one achieves deposition velocities and effective half-lives, respectively, which agree very well with values already known. For depth profiles of Ra-226, Pb-210, and Po-210 in soil of a meadow and a heap, the interpretation of the results achieved is difficult, since the processes of contamination and decontamination are very complicated. Still after more than one and a half century the transport of Ra-226 from the uraniferous material to deeper soil layers is negligible. The transport of Pb-210 and Po-210 is much faster.

8317 (NVO—213) Enewetak radiological support project. Final report. Friesen, B. (ed.). (USDOE Nevada Operations Office, Las Vegas; Holmes and Narver, Inc., Orange, CA (USA)). Sep 1982. 669p. NTIS PCE19/MF $5.50. Order Number DE83003674.

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From 1972 through 1980, the Department of Energy acted in an advisory role to the Defense Nuclear Agency during planning for and execution of the cleanup of Enewetak Atoll. The Nevada Operations Office of the Department of Energy was responsible for the radiological characterization of the atoll and for certification of radiological condition of each island upon completion of the project. In-situ measurements of gamma rays emitted by americium-241 were utilized along with wet chemistry separation of plutonium from soil samples to identify and delineate surface areas requiring removal of soil. Military forces removed over 100,000 cubic yards of soil from the surface of five islands and deposited this material in a crater remaining from the nuclear testing period. Subsurface soil was excavated and removed from several locations where measurements indicated the presence of radionuclides above predetermined criteria. The methodologies of data acquisition, analysis and interpretation are described and detailed results are provided in text, figures and microfiche. The final radiological condition of each of 43 islets is reported.

8318 Sorption of uranium and cesium by Hanford basalts and associated secondary smectite. Ames, L.L. (Pacific Northwest Lab., Richland, WA); McGarrah, J.E.; Walker, B.A.; Salter, P.F. *Chemical Geology;* **35**: 205-225(1982).

Three characterized basalts and an associated secondary smectite were used in comparative uranium and cesium sorption studies. Experiments utilizing two synthetic characteristic basalt groundwaters at 23 and 60°C allowed comparison of increased temperature and carbon concentration effects on Cs and U sorption. The sorption data were fitted to the Dubinin-Radushkevich (D-R) isotherm, and loading maxima and energetics derived. An increase in temperature caused a decrease in Cs sorption maxima on all solids from all groundwaters studied and an increase in U sorption maxima, especially from the higher-carbonate-content groundwater. Sorption energies were characteristic of ion exchange for both Cs and U sorption processes. Basalt U sorption maxima were relatively insignificant, but smectite U sorption maxima surpassed Cs sorption maxima in both groundwaters at 60°C. The uranyl carbonate complexes thus may be relatively temperature-sensitive. Upon removal of excess Fe-oxides from the secondary smectite, U sorption decreased and the D-R isotherm reverted to a normal Freundlich sorption isotherm. Removal of excess Fe-oxides from the basalts and secondary smectite would probably result in Freundlich sorption isotherms for both Cs and U.

8319 (ORNL-tr—4890) Plutonium in grain and soil. Frindik, O. Translated from *Lebensmittel-Wissenschaft und Technologie ;* **10**: 162-165(1977). Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE83000251.

Portions of document are illegible.

Grain samples from the vicinity of the Karlsruhe Nuclear Center and from distant areas had mean ^{239}Pu and ^{240}Pu contents of 0.001 +- 0.002 pCi/kg in the years 1972 to 1975. Total alpha-activity, consisting mostly of the natural alpha emitters 000 of the Th- and U-series was 8.6 +- 1.6 pCi/kg. In soil samples taken from the fields where the grain had been grown, the mean ^{239}Pu and ^{240}Pu content was 7.7 +- 1.7 pCi/kg and the mean total activity was 16 +- 5.0 . 10^3 pCi/kg. The plutonium concentration in soil was thus higher by a factor of 680 +- 180 as compared to that in the grain. No increased plutonium contamination was observed in the vicinity of the nuclear center.

8320 (ORNL-tr—4898) Plutonium alpha activity of foods. Frindik, O.; Diehl, J.F. Translated from *Deutsche Lebensmittel-Rundschau ;* **71**: No. 3, 100-104(1975). Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01. Order Number DE83000009.

Portions of document are illegible.

The plutonium contents of some foodstuffs and of total daily diets (including beverages) of adults were determined. For this purpose all samples were dry-ashed at 400°C, mixed with ^{236}Pu as an internal standard, and the Pu-isotopes were estimated by means of alpha-spectrometry. Only in one of the 28 daily rations was a $^{239}Pu/^{240}Pu$-value and in another one a ^{238}Pu-value found that was above the detection limit of 6 fCi. Of the individual foodstuffs of animal origin only one of four beef liver samples had a plutonium content that can be considered as statistically significant. Some unpeeled foodstuffs of vegetable origin (apples, pears, wheat) also showed a measurable plutonium content. In all instances the measured plutonium activity was within the range that was to be expected due to the present contamination of the biosphere by nuclear tests ($^{239}Pu/^{240}Pu$) and by satellite batteries (^{238}Pu).

8321 (ORNL-tr—4912) Study of the accumulation of uranium in the kidneys and bone tissue with chronic enteral administration. Novikov, Yu.V. Translated from *Gigiena i Sanitariya ;* **37**: No. 6, 109-110(Jun 1972). Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE83001769.

The accumulation of uranium in the kidneys and skeleton of female white rats was studied. The uranium was administered chronically in drinking water in various average annual permissible

concentrations. Results indicate that uranium concentrates in the skeleton by a factor of 10 more than in the kidneys. Concentrations and dose rates are given. (ACR)

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 6784, 6841, 6842, 6843, 8352

8322 **Recovery of streamside woody vegetation after exclusion of livestock grazing.** Rickard, W.H.; Cushing, C.E. (Pacific Northwest Lab., Richland, WA). *Journal of Range Management;* 35: No. 3, 360-361(May 1982). Contract AC06-76RL01830.

Removal of livestock grazing along a small, perennial desert stream allowed the reestablishment of woody vegegation (Salix amygdaloides) in the riparian zone within 10 years.

5106 Regulations

8323 **(PB—82-213992) Notification of hazardous waste sites required under section 103(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980: EPA Region 1.** (Environmental Protection Agency, Washington, DC (USA)). Mar 1982. 170p. NTIS, PC A08/MF A01.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 PL 96-510 (commonly known as Superfund) mandates in Section 103(c) that certain persons notify the U.S. Environmental Protection Agency (EPA) by June 9, 1981 of the existence of sites where hazardous wastes from industries, businesses, government, hospitals, and other sources are stored, treated or disposed of. This document comprises a listing of 8,755 notifications of hazardous waste sites. For each notification, the listing summarizes the location, the persons required to notify, the amount and type of any hazardous waste to be found on the site reported, and any known or suspected releases of hazardous wastes. The CERCLA 103(c) notification was mandated to help EPA and State and local governments remedy problems created by uncontrolled hazardous waste disposal. This document contains ten volumes, one for each EPA region. Within each volume, the notifications are presented alphabetically by state and site name within each state, respectively.

8324 **(PB—82-214024) Notification of hazardous waste sites required under section 103(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980: EPA Region 4.** (Environmental Protection Agency, Washington, DC (USA)). Mar 1982. 474p. NTIS, PC A20/MF A01.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 PL 96-510 (commonly known as Superfund) mandates in Section 103(c) that certain persons notify the U.S. Environmental Protection Agency (EPA) by June 9, 1981 of the existence of sites where hazardous wastes from industries, businesses, government, hospitals, and other sources are stored, treated or disposed of. This document comprises a listing of 8,755 notifications of hazardous waste sites. For each notification, the listing summarizes the location, the persons required to notify, the amount and type of any hazardous waste to be found on the site reported, and any known or suspected releases of hazardous wastes. The CERCLA 103(c) notification was mandated to help EPA and State and local governments remedy problems created by uncontrolled hazardous waste disposal. This document contains ten volumes, one for each EPA region. Within each volume, the notifications are presented alphabetically by state and site name within each state, respectively.

8325 **(PB—82-214040) Notification of hazardous waste sites required under section 103(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980: EPA Region 6.** (Environmental Protection Agency, Washington, DC (USA)). Mar 1982. 379p. NTIS, PC A17/MF A01.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 PL 96-510 (commonly known as Superfund) mandates in Section 103(c) that certain persons notify the U.S. Environmental Protection Agency (EPA) by June 9, 1981 of the existence of sites where hazardous wastes from industries, businesses, government, hospitals, and other sources are stored, treated or disposed of. This document comprises a listing of 8,755 notifications of hazardous waste sites. For each notification, the listing summarizes the location, the persons required to notify, the amount and type of any hazardous waste to be found on the site reported, and any known or suspected releases of hazardous wastes. The CERCLA 103(c) notification was mandated to help EPA and State and local governments remedy problems created by uncontrolled hazardous waste disposal. This document contains ten volumes, one for each EPA region. Within each volume, the notifications are presented alphabetically by state and site name within each state, respectively.

8326 **(PB—82-214065) Notification of hazardous waste sites required under section 103(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980: EPA Region 8.** (Environmental Protection Agency, Washington, DC (USA)). Mar 1982. 123p. NTIS, PC A06/MF A01.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 PL 96-510 (commonly known as Superfund) mandates in Section 103(c) that certain persons notify the U.S. Environmental Protection Agency (EPA) by June 9, 1981 of the existence of sites where hazardous wastes from industries, businesses, government, hospitals, and other sources are stored, treated or disposed of. This document comprises a listing of 8,755 notifications of hazardous waste sites. For each notification, the listing summarizes the location, the persons required to notify, the amount and type of any hazardous waste to be found on the site reported, and any known or suspected releases of hazardous wastes. The CERCLA 103(c) notification was mandated to help EPA and State and local governments remedy problems created by uncontrolled hazardous waste disposal. This document contains ten volumes, one for each EPA region. Within each volume, the notifications are presented alphabetically by state and site name within each state, respectively.

8327 **(PB—82-214073) Notification of hazardous waste sites required under section 103(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980: EPA Region 9.** (Environmental Protection Agency, Washington, DC (USA)). Mar 1982. 284p. NTIS, PC A13/MF A01.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 PL 96-510 (commonly known as Superfund) mandates in Section 103(c) that certain persons notify the U.S. Environmental Protection Agency (EPA) by June 9, 1981 of the existence of sites where hazardous wastes from industries, businesses, government, hospitals, and other sources are stored, treated or disposed of. This document comprises a listing of 8,755 notifications of hazardous waste sites. For each notification, the listing summarizes the location, the persons required to notify, the amount and type of any hazardous waste to be found on the site reported, and any known or suspected releases of hazardous wastes. The CERCLA 103(c) notification was mandated to help EPA and State and local governments remedy problems created by uncontrolled hazardous waste disposal. This document contains ten volumes, one for each EPA region. Within each volume, the notifications are presented alphabetically by state and site name within each state, respectively.

8328 **(PB—82-214081) Notification of hazardous waste sites required under section 103(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980: EPA Region 10.** (Environmental Protection Agency, Washington, DC (USA)). Mar 1982. 142p. NTIS, PC A07/MF A01.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 PL 96-510 (commonly known as Superfund) mandates in Section 103(c) that certain persons notify the U.S. Environmental Protection Agency (EPA) by June 9, 1981 of the existence of sites where hazardous wastes from

industries, businesses, government, hospitals, and other sources are stored, treated or disposed of. This document comprises a listing of 8,755 notifications of hazardous waste sites. For each notification, the listing summarizes the location, the persons required to notify, the amount and type of any hazardous waste to be found on the site reported, and any known or suspected releases of hazardous wastes. The CERCLA 103(c) notification was mandated to help EPA and State and local governments remedy problems created by uncontrolled hazardous waste disposal. This document contains ten volumes, one for each EPA region. Within each volume, the notifications are presented alphabetically by state and site name within each state, respectively.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 7576, 8352, 8889

8329 **(FWS/OBS—82/25) Ecology of the seagrasses of south Florida: a community profile.** Zieman, J.C. (Virginia Univ., Charlottesville (USA). Dept. of Environmental Sciences). Sep 1982. 161p. NTIS, PC A08/MF A01. Order Number DE83900362.

Portions of document are illegible.

A detailed description is given of the community structure and ecosystem processes of the seagrass ecosystems of south Florida. This description is based upon a compilation of information from numerous published and unpublished sources. The material covered includes distribution, systematics, physiology, and growth of the plants, as well as succession and community development. The role of seagrass ecosystems in providing both food and shelter for juveniles as well as foraging grounds for larger organisms is treated in detail. Emphasis is given to the functional role of seagrass communities in the overall coastal marine system. The final section considers the impacts of human development on seagrass ecosystems and their value to both man and the natural system. Because seagrass systems are fully submerged and less visually obvious, recognition of their value as a natural resource has been slower than that of the emergent coastal communities. They must, however, be treated as a valuable natural resource and preserved from further degradation.

8330 (KFK-AFR—003, pp 28) **Trace element analysis in river water, floating particles and sediments by means of instrumented NAA and application of activable tracers in investigations of floating particle and sediment transport.** Grueneberg, M.; Calmano, W.; Lieser, K.H. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8331 (KFK-AFR—003, pp 31) **Analysis of trace elements in sea water.** Ammann, K.; Knoechel, A.; Prange, A. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8332 **Design for aquatic monitoring programs.** Skalski, J.R.; McKenzie, D.H. (Pacific Northwest Lab., Richland, WA). *Journal of Environmental Management;* **14**: 237-251(1982). Contract AC06-76RL01830.

An objective of ecological aquatic monitoring at nuclear power plants has been the detection of impacts on the important fauna and flora in the vicinity of the plant site. A control-treatment pairing (CTP) design for monitoring programs is presented for impact assessment in benthic and plankton communities. A scheme for the establishment of monitoring programs using CTP designs is discussed which accounts for the influence of plant site characteristics, the quantitative objectives of the monitoring study, the expected magnitude of experimental error and the limitations of time and effort. A graphical technique is presented which can be used to incorporate these often competing constraints into the design of aquatic monitoring studies. Estimates of the experimental error computed from a posteriori applications of CTP designs to benthic and plankton communities at six nuclear power plants are presented.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 6945, 6946, 6976, 6977, 6980, 8028, 8301, 8442

8333 **(CONF-8105118—) Proceedings of the first national ground-water-quality-monitoring symposium and exposition.** (National Water Well Association, Worthington, OH (USA); Environmental Protection Agency, Ada, OK (USA)). 1981. 94p. NTIS, PC A05/MF A01. Order Number DE82905817.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

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Separate abstracts were prepared for 8 of the 14 papers in this proceedings of the First National Ground Water Quality Monitoring Conference and Exposition. The six papers not abstracted include two papers on radioactive waste disposal that are already in the EDB data base, and four papers dealing with regulations and significance testing of ground water monitoring. (KRM)

8334 (CONF-8105118—, pp 5-10) **Methodology for monitoring ground-water quality degradation.** Tinlin, R.M. 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

In 1976, The General Electric Company's Center for Advanced Studies completed the development of a 15-step methodology for monitoring the effect of man's activities on ground-water quality when the methodology was applied to energy-related development in the Western US, it became apparent that the methodology needed to be applied in an iterative manner when dealing with a multi-source area. It became obvious that the objectives at each step are significantly different for those at the administrative, regulatory level and at the site-specific level. This paper presents a modified version of the framework for monitoring ground-water quality to accommodate these needs. (KRM)

8335 (CONF-8105118—, pp 11-20) **Problems of monitoring network design to detect unanticipated contamination.** Pfannkuch, H.O. 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

Strategies to handle the unanticipated release and propagation of contaminants in the ground water flow system are presented. Two situations are dealt with in this article. The first problem is the accidental occurrence of spills at a point along an extended, linear route such as a pipeline break or a tank car accident. The second problem involves leachate generation and propagation from unregulated or pre-regulation abandoned land disposal operations. Both problems have an unforeseeable element of chance or randomness involving the unknown location and time of the first situation, and the unknown location, nature and strength of the source in the second situation. The strategy of field monitoring and information gathering procedures pertinent to these problems are discussed. The monitoring system design and operation are outlined. Several field examples and applications are presented. (KRM)

8336 (CONF-8105118—, pp 21-30) **Monitoring in the vadose zone.** Wilson, L.G. (Univ. of Arizona, Tucson). 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

The geological profile exending from the ground surface to the upper surface of a principal water-bearing formation is called the vadose zone. Monitoring within the vadose zone underlying a surface pollution source affords an early warning of potential ground water pollution. This is one of three articles in a series, the purpose of which is to provide a prime on techniques for vadose

zone monitoring. This article deals with methods for determining storage and storage changes within this zone, and methods for monitoring these changes. A detailed catalog of methods for monitoring water content in the vadose zone is presented which summarizes the principles of operation, together with major advantages and disadvantages of each method. (KRM)

8337 (CONF-8105118—, pp 31-39) **Monitoring of leachate migration in the unsaturated zone in the vicinity of sanitary landfills.** Johnson, T.M.; Cartwright, K.; Schuller, R.M. (Illinois State Geological Survey, Champaign). 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

This paper reports on a project to investigate the movement and quality of leachate in the unsaturated zone beneath several landfills in Illinois and to evaluate methods of monitoring soil-moisture and ground water conditions. Contaminant migration was monitored by means of observation wells and soil-water samplers (pressure-vacuum lysimeters) and by chemical analysis of soil samples. In addition, a laboratory study was conducted in a preliminary attempt to determine if there are any factors that significantly affect the validity of samples of highly contaminated landfill leachate collected with pressure-vacuum lysimeters. The results indicated the presence of leachate contamination beneath each landfill studied. (KRM)

8338 (CONF-8105118—, pp 40-42) **Positive displacement ground-water sampling device.** Gillham, R.W.; Johnson, P.E. (Waterloo Univ., Ontario). 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

This paper describes a modification of a multi-level ground water sampling device consisting of small screens inserted in the side of a PVC pipe. The modification allows water to be collected through the use of positive pressure rather than section. As a result, samples can be collected in situations where the water table is at a substantial depth and the potential for loss of volatile constituents of the ground water is greatly reduced. The operational experience with this device is discussed. (KRU)

8339 (CONF-8105118—, pp 43-47) **Recommended sampling procedures for monitoring wells.** Schuller, R.M. (Illinois State Geological Survey, Champaign); Gibb, J.P.; Griffin, R.A. 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

Monitoring wells are the principal source of data for evaluating the effects of waste disposal sites on ground water. The objective of this study was to develop a sampling protocol for monitoring wells which includes criteria for selection of an appropriate pumping mechanism; procedures for determining the necessary extent of well flushing before a sample should be collected; and procedures for sample preparation, preservation and storage. (KRM)

8340 (CONF-8105118—, pp 59-66) **Ground-water monitoring techniques for arid zone hazardous waste disposal sites.** Kaufmann, R.F.; Gleason, T.A.; Ellwood, R.B.; Lindsey, G.P. 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

Selected ground water monitoring techniques are presented for use in waste disposal facilities in arid zone settings of the southwest. Completion of wells in poorly consolidated bedrock and in alluvium is greatly facilitated by the use of polymer drilling fluids to stabilize the boring of the PVC, ABS and steel casing and screen materials used, the plastic materials were easiest to install, but presented a possible source of trace organic contaminants in the water samples. Penetration of hazardous wastes using driven cyclindrical piles was safe and practical for confirming waste thickness and saturation. Although not completely diagnostic, differences in the overall pattern of chromatograms representative of natural hazardous waste-related hydrocarbons are useful in defining contamination. (KRM)

8341 (CONF-8105118—, pp 67-73) **Cause and effect of cyclic changes in ground-water quality.** Pettyjohn, W.A. 1981. NTIS, PC A05/MF A01.

From 1. groundwater monitoring symposium; Columbus, OH, USA (29 May 1981).

This paper discusses the mechanisms that lead to cyclic fluctuations of ground water quality. Both the cause and effect of these fluctuations can have a significant impact on ground water quality monitoring and determination of background water quality; transport and fate of organic and inorganic compounds, as well as bacteria and viruses; and monitoring well design and installation. The effects of storage of large concentrations of water soluble substances, such as oil-field brine, within the unsaturated zone are described. Pathways for water movement and contaminant transport in the unsaturated zone are also described. (KRM)

8342 (DOE/EV/10228—T1) **Carbon dioxide measurements in the equatorial Pacific. Final technical report.** Weiss, R.F. (Scripps Institution of Oceanography, La Jolla, CA (USA)). 1980. Contract AT03-79EV10228. 14p. NTIS, PC A02/MF A01. Order Number DE82021246.

The research was focussed on the measurement of carbon dioxide, nitrous oxide, and methane in the atmosphere and surface ocean waters of the central tropical Pacific Ocean during the Norpax Equatorial Experiment. An ancillary objective of this work was the construction of an automated gas chromatographic instrument to carry out these measurements, with special emphasis on the refinement of techniques developed earlier for routine high-precision measurement of carbon dioxide by dual-catalyst gas chromatography. The research led to significant new instrumental developments and to the collection of a data set for the study of environmentally important trace gases in the equatorial Pacific Ocean and atmosphere.

8343 (Juel—1722) **Anthropogenic proportion of atmospheric sulphur and nitrogen cycle and possible global effects on chemical conversions in the atmosphere.** Janssen-Schmidt, T.; Roeth, E.P.; Varhelyi, G.; Gravenhorst, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Atmosphaerische Chemie). Jul 1981. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750977.

The studies lead to the following changes in the photochemical equilibrium of the atmosphere taking into account the time formation of the anthropogenic proportion of the SO_2 or NOsub(x) source strength from 1972-2020: The expected trebling of the anthropogenic SO_2 emission only influences the sulphur cycle. It leads to the doubling of the SO_2 concentration on the ground. The influence is lower the higher the concentration and is only 20% in the middle troposphere (approx. equal to 5 km). An enrichment of 120% of H_2SO_4 aerosol is simultaneously reached with analogous height characteristics. The increasing anthropogenic emission of SO_2 does not lead to an increased SO_2 concentration with the simultaneous rise of the anthropogenic NOsub(x) emission by 150% in the same period. This is due to the increased destruction of SO_2 by the OH radical. The change of the anthropogenic source strength of NOsub(x) at the ground by 150% up to the year 2020 leads to increased formation of ozone in the troposphere and thus to an increase of the tropospheric ozone column by 14%. OH effects the carbon cycle via oxidation processes. The increase of OH by anthropogenic growth of the NOsub(x) emission causes a reduction of 17% or 15% in the CH_4- or CO-mixture ratio.

8344 (NUREG/CR—2838) **Hydroacoustic biomass estimation techniques.** Kanciruk, P. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 284p. (ORNL/TM—8304). NTIS, PC A13/MF A01. Order Number DE83003192.

Portions of document are illegible.

The use of hydroacoustic (sonar) biomass estimation techniques as they might apply to power plant aquatic environmental monitoring programs is discussed. Background information on the physics of sound in water and basic hydroacoustic equipment is presented. The hydroacoustic literature is reviewed with examples provided of successful technique application toward a variety of

monitoring and assessment goals. The results of a hydroacoustic user survey are presented in an appendix, along with an extensive, computer-indexed hydroacoustic bibliography. Hydroacoustic biomass estimation techniques are quantitative, cost-effective stock assessment tools, providing information not obtainable with more traditional survey methods. Hydroacoustic techniques are particularly adaptable to monitoring programs at power plant sites and should be strongly considered in designing operational monitoring systems. 430 references.

8345 **Biodegradation and gas-exchange of gaseous alkanes in model estuarine ecosystems.** Bopp, R.F. (Columbia Univ., Palisades, NY); Santschi, Y.L.; Deck, B.L. *Organic Geochemistry;* 3: 9-14(1981).

Gas exchange-biodegradation experiments conducted in model estuarine ecosystems indicate that the ease of degradation of gaseous normal alkanes increases with chain length. The behaviour of gaseous perhalogenated alkanes can be explained by gas exchange alone with no degradation. The initial degradation of C_5 and C_4 alkanes proceeded with half times of a few days to a few weeks, however, after a period of 15-30 days, the rates of degradation increased by at least an order of magnitude.

8346 **Effects of oiled sediment on predation on the littleneck clam, Protothaca staminea, by the Dungeness crab, Cancer magister.** Pearson, W.H. (Battelle Pacific Northwest Labs., Sequim, WA); Woodruff, D.L.; Sugarman, P.C.; Olla, B.L. *Estuarine, Coastal and Shelf Science;* 13: 445-454(1981). Contract AC06-76RL01830.

Field and laboratory experiments examined how oiled sediment influenced predation on littleneck clams, Protothaca staminea, by Dungeness crabs, Cancer magister. In two field enclosure experiments lasting 13 and 29 days crabs consumed more clams from oiled than clean sand. Clams were shallower in oiled than clean sand. To test whether the observed increase in predation rate on clams from oiled sand was due to shallow burial, a 19-day laboratory experiment examined predation rates on clams buried in different depths of sand. The high consumption of clams from shallow-clean sand indicated that shallow burial could have accounted for most but not all the higher consumption of clams in oiled sand. In a second laboratory experiment without crabs, clams were again shallower in oiled than clean sand. Clams did not actively emerge from oiled sand but did burrow slower into oiled sand. Shallow burial and slow reburrowing in oiled sand led to increased predation of littleneck clams through increasing the accessibility of clams to Dungeness crabs.

8347 **Workshop on the analysis of hydrocarbons in seawater.** (Universitaet Kiel, Germany). *Baltic Sea Environment Proceedings;* No. 6, 1-52(1981).

The determination of hydrocarbons and their concentrations in seawater were considered from the points of view of environmental monitoring of marine pollution by fossil fuels and/or research aiming at the elucidation of compositional features, persistence, pathways and final elimination of these compounds from the aqueous phase. Methods for dealing with the different aspects of hydrocarbon analysis in seawater were reviewed during an overview of the most recent developments in marine oil pollution related research.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 6986, 7278, 8065, 8303, 8317

8348 **(ORNL—5878) Technical background information for the environmental and safety report, Volume 5: the 1977 Clinch River sediment survey - data presentation.** Oakes, T.W.; Ohnesorge, W.F.; Eldridge, J.S.; Scott, T.G.; Parsons, D.W.; Hubbard, H.M.; Sealand, O.M.; Shank, K.E.; Eyman, L.D. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 317p. NTIS, PC A14/MF A01. Order Number DE83003350.

This study determined the fate and distribution of nuclides in the Clinch River by analyzing selected cores for transuranic radionuclide activity and examined the effect of the altered flow regime in the Clinch River on the distribution of the fission product activity. Cores were collected along the full length of the Clinch River from the WOC outfall (CRM 20.8) to locations in the Tennessee River on either side of the junction of the two rivers. The sampling was concentrated around CRM 20.8 and the proposed CRBR site. An inventory of alpha-emitting radionuclides and gamma-emitting fission products and their lateral and vertical distribution patterns in the Clinch River was established.

8349 **(UCRL—52853-Pt.4) Northern Marshall Islands radiological survey: terrestrial food chain and total doses.** Robison, W.L.; Mount, M.E.; Phillips, W.A.; Conrado, C.A.; Stuart, M.L.; Stoker, C.E. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1982. Contract W-7405-ENG-48. 154p. NTIS, PC A08/MF A01. Order Number DE83003106.

A radiological survey was conducted from September through November of 1978 to assess the concentrations of persistent manmade radionuclides in the terrestrial and marine environments of 11 atolls and 2 islands in the Northern Marshall Islands. The survey consisted mainly of an aerial radiological reconnaissance to map the external gamma-ray exposure rates over the islands of each atoll. The logistical support for the entire survey was designed to accommodate this operation. As a secondary phase of the survey, shore parties collected appropriate terrestrial and marine samples to assess the radiological dose from pertinent food chains to those individuals residing on the atolls, who may in the future reside on some of the presently uninhabited atolls, or who collect food from these atolls. Over 5000 terrestrial and marine samples were collected for radionuclide analysis from 76 different islands. Soils, vegetation, indigenous animals, and cistern water and groundwater were collected from the islands. Reef and pelagic fish, clams, lagoon water, and sediments were obtained from the lagoons. The concentration data for ^{90}Sr, ^{137}Cs, ^{239}Pu, $^{239,240}Pu$, and ^{241}Am in terrestrial food crops, fowl, and animals collected at the atolls or islands are summarized. An assessment of the total dose from the major exposure pathways including external gamma, terrestrial food chain including food products and drinking water, marine food chain, and inhalation is provided. Radiological doses at each atoll or island are calculated from the average radionuclide concentrations in the terrestrial foods, marine foods, etc. assuming the average daily intake for each food item.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 6840, 6842, 7230

8350 **(TVA/OECD/FPM—82/20) Floods on west prong Little Pigeon River, Dudley Creek, Roaring Fork Creek, Baskins Creek, and Le Conte Creek in the vicinity of Gatlinburg, Tennessee.** (Tennessee Valley Authority, Knoxville (USA). Office of Economic and Community Development). Sep 1982. 144p. NTIS, PC A07/MF A01. Order Number DE83900059.

8351 **(TVA/OECD/FPM—82/23) Floods on Tennessee River and Cypress and Little John Creeks in the vicinity of Calvert City, Kentucky.** (Tennessee Valley Authority, Knoxville (USA). Office of Economic and Community Development). Sep 1982. 104p. NTIS, PC A06/MF A01. Order Number DE83900058.

This report on the extent and severity of flooding along the Tennessee River, Cypress Creek, and Little John Creek in the vicinity of Calvert City, Kentucky, has been prepared as a result of a need for updated flood hazard information to assist in planning for future development in and around Calvert City. Revised profiles and flooded area and floodway maps are provided for Tennessee River, Cypress Creek, and Little John Creek.

53 ENVIRONMENTAL-SOCIAL ASPECTS

OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 7221, 7765, 7825, 8289, 8896

8352 (ORNL—5870) Environmental analysis of the operation of Oak Ridge National Laboratory (X-10 site). Boyle, J.W.; Blumberg, R.; Cotter, S.J. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 245p. NTIS, PC A11/MF A01. Order Number DE83003186.

Portions of document are illegible. Printed copy available until stock is exhausted.

An environmental analysis of the operation of the Oak Ridge National Laboratory (ORNL) facilities in Bethel Valley and Melton Valley was conducted to present to the public information concerning the extent to which recognizable effects, or potential effects, on the environment may occur. The analysis addresses current operations of the ORNL X-10 site and completed operations that may continue to have residual effects. Solid wastes from ORNL operations at the Y-12 site which are transported to the X-10 site for burial (e.g., Biology Division animal wastes) are included as part of X-10 site operation. Socioeconomic effects are associated primarily with the communities where employees live and with the Knoxville Bureau of Economic Analysis economic area as a whole. Therefore, ORNL employees at both Y-12 and X-10 sites are included in the ORNL socioeconomic impact analysis. An extensive base of environmental data was accumulated for this report. Over 80 reports related to ORNL facilities and/or operations are cited as well as many open-literature citations. Environmental effects of the operation of ORNL result from operational discharges from the onsite facilities; construction and/or modification of facilities, transportation to and from the site of persons, goods and services; socioeconomic impacts to the local, regional, and general population; and accidental discharges if they should occur. Operational discharges to the environnment are constrained by federal, state, and local regulations and by criteria established by the US Department of Energy to minimize adverse impacts. It is the purpose of this document to evaluate the operation of the ORNL insofar as impacts beyond the site boundary may occur or have the potential for occurrence.

8353 Class relations, center-periphery relations and the rural energy crisis. Wisner, B. (Univ. of Wisconsin, Madison). pp 40-71 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The author states that it is misleading and wasteful to focus research and policy on the rural energy crisis. This energy crisis is more usefully conceived as a particular manifestation of the crisis of reproduction at the heart of family-based production systems. This paper undertakes to defend such a reinterpretation of the so-called other energy crisis and to suggest methodological and policy implications of such a refocused problem statement. An empirically and historically grounded model of the articulation (or interpenetration) of capitalist and noncapitalist modes of production in Africa are summarized. (RJC)

8354 Village energy use: a futures outlook. Howe, J. (Solar Energy Research Inst., Golden, CO). pp 72-74 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The question of what is the future of decentralized renewable energy for the rural Third World is discussed. Six points are identified which need to be addressed before the question can be resolved. They are: a knowledge of the physical performance of a variety of technologies under actual Third World village conditions; information on which technologies are best suited to fulfill the village needs; more information about the people in the villages; data on the cost of the technology; the cultural acceptability of the technology; and what institution in the village will take responsibility for owning, operating, repairing of equipment, and distributing the benefits of the technology. (RJC)

8355 Ecopolitical economy of agricultural innovation. Yapa, L.S. (Pennsylvinia State Univ., State College). pp 118-137 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Until the seventies, consideration of social relations and ecological problems in economic development of Third World nations was not a concern. In this paper, using the Green Revolution as an example, the author presents a framework of analysis called ecopolitical economy to examine questions of technology and economic development. The Baran-Frank hypothesis of the development of underdevelopment is extended to microlevel village studies by arguing that the Green Revolution served as a mechanism for the reproduction of rural inequality. (RJC)

8356 Issues of women, energy, and appropriate technologies in developing countries. Tinker, I. (Equality Policy Center, Washington, DC). pp 319-326 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

One-half of the energy in developing countries is consumed by household and homecraft activities-largely the work of women. This article discusses some considerations that should be taken into account before intervening to change energy use at the village level, whether for fuel or for appropriate technology. Total time budget and the roles that women play as users of new technologies are described. (RJC)

8357 Implications of women's role in food preparation in rural homes in Nepal. Molnar, A. pp 327-344 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper outlines ways in which improvements in food preparation and the use of energy in households would benefit women and the community in the light of women's role in the household and rural economy. Examined are the social, cultural, and economic factors that must be considered to successfully introduce new methods and technologies. The community of Thabang, Nepal is used as an example in this study. (RJC)

8358 Constraints to womens' sphere of action and use of energy in village India. Dandekar, H. (Univ. of Michigan, Ann Arbor). pp 345-357 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The development of new energy sources in the rural areas of Indian are discussed under the following headings: the village, women farmers; land ownership; women agricultural laborers; nonagricultural activities; education and jobs; women's social and work spheres; family, marriage, and status; social security; men's and women's social spheres; and prognosis for change. Development programs have an impact upon rural society resulting in a struggle between the old and the new ways. The way in which this struggle

has been played out with particular reference to its effect on women is described in this paper. (RJC)

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 7151

8359 (EPRI-EL—2572, pp 7.11-7.17) **Sunohio PCBX process and field experience.** Norman, O.L. Sep 1982. NTIS, PC A13/MF A01.

From Electric Power Research Institute seminar on PCB; Dallas, TX, USA (1 Dec 1981).

Sunohio PCBX process is evaluated by electric utilities and industrial organizations. Operational costs and equipment costs are listed.

8360 **Framework for evaluating the economics of renewable energy technologies: an approach to economic evaluation.** Shaikh, A. (Energy/Development International, Washington, DC). pp 179-208 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The objective of this paper is to develop a simple and usable framework for the economic evaluation of renewable energy technologies in developing nations. Until recently, limited attention has been paid to the need to evaluate the economics of technologies being offered to beneficiaries in the Third World. Even once the need is recognized, however, an appropriate definition of the criteria by which the economic soundness of renewable energy technologies should be judged can be quite elusive. The first and most fundamental issue for economic evaluation is to determine the perspectives from which feasibility should be analyzed. A second, related issue is one of scope. A third issue, and one that underlies the entire framework for economic evaluation, is that of incentive; what are the incentives to possess a technology, to promote it, and transmit it. The economic evaluations of mud stoves, wood ovens and wind-powered water pumps in developing nations are discussed. (RJC)

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 7012, 7055, 7056, 8305

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 8391, 8437, 8454

8361 (KFK-AFR—003, pp 40) **Development of new analytical methods using radioactive tracers. Example of application: Gas phase separations in light-conductivity substances and biological samples.** Baechmann, K.; Fuchs, G.; Pohl, B.; Spachidis, C.; Weitz, A. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8362 **Extracellular acid proteases from Neurospora crassa.** Lindberg, R.A. (Pacific Northwest Lab., Richland, WA); Rhodes, W.G.; Eirich, L.D.; Drucker, H. *Journal of Bacteriology;* **150**: No. 3, 1103-1108(Jun 1982). Contract AC06-76RL01830.

Three electrophoretically distinct acid proteases appear in culture filtrates of Neurospora crassa. Like the previously investigated alkaline and neutral proteases, these enzymes require induction by an exogenous protein. But in contrast to alkaline and neutral proteases, which are synthesized and secreted in response to limitation of any one of three nutrilites (carbon, nitrogen or sulfur), extracellular elaboration of the acidic proteases is more specifically a function of the missing nutrilite. AcP, a pepstatin-inhibitable enzyme similar to other fungal carboxyl proteases, was secreted in large amounts when protein was the sole source of sulfur. Only trace amounts were secreted when nitrogen was the limiting nutrilite, and it was undetectable under carbon limitation. M-1, a chelator-sensitive protease, was secreted when nitrogen or carbon was limiting. M-2, also chelator sensitive, was present only when nitrogen or sulfur was limiting. The evidence presented suggests that the differential regulation of the acidic proteases with respect to nutrilite deprivation may not occur at the level of transcription. AcP and M-2 were partially purified from nitrogen-derepressed cultures by ultrafiltration, cation-exchange chromatography, and gel filtration. AcP has a molecular weight of 66,000, is stable from pH 3.0 to 6.0, and is optimally active toward bovine serum albumin at pH 4.0. M-2 has a molecular weight of 18,000, is stable from pH 1.6 to 5.5, and has optimal activity at pH 4.5.

8363 **Properties of native and immobilised preparations of beta-d-glucosidase from Aspergillus niger.** Woodward, J.; Wohlpart, D.L. (Bioprocess Research and Development Group, Chemical Tech Div, Oak Ridge National Lab, Oak Ridge, TN 37830, USA). *Journal of Chemical Technology and Biotechnology;* **32**: No. 4, 547-552(Apr 1982).

The enzyme beta-glucosidase from Aspergillus niger has been immobilised through its carbohydrate moiety on concanavalin A-Sepharose and on cyanogen bromide-activated Sepharose after aminoalkylation of the carbohydrate side chains of the enzyme. For comparison, the enzyme was also immobilised on microcrystalline cellulose through its protein moiety. High retention of activity and a decrease in Km and Vmax were observed when beta-D-glucosidase was immobilised by these methods. An increase in the thermal stability of the immobilized beta-D-glucosidase preparations over the soluble enzyme was achieved if it was treated with glutaraldehyde before its adsorption on concanavalin A-Sepharose or if the enzyme immobilised on cyanogen bromide-activated Sepharose was subsequently treated with glutaraldehyde. Treatment of beta-D-glucosidase immobilised on microcrystalline cellulose with glutaraldehyde hardly increased its thermal stability over the soluble enzyme. (Refs. 24).

8364 **Specificity of the photoreaction of 4'-(hydroxymethyl)-4,5',8-trimethylpsoralen with ribonucleic acid. Identificaton of reactive sites in Escherichia coli phenylalanine-accepting transfer ribonucleic acid.** Bachellerie, J.P.; Hearst, J.E. (Univ. of California, Berkeley). *Biochemistry;* **21**: No. 6, 1357-1363(16 Mar 1982). Contract W-7405-ENG-48.

In order to test the potential of psoralen photo-addition for the probing of RNA conformation at sequence resolution, the specificity of the reaction of 4'-(hydroxymethyl)-4,5',8-trimethylpsoralen (HMT) with Escherichia coli tRNA/sup Phe/ was analyzed. The sites of HMT covalent addition have been identified by a combination of analytical techniques involving chemical cleavage of the tRNA/sup Phe/ molecule at the m^7G site and gel electrophoresis of RNase T_1 digests together with paper electrophoretic characterization of HMT-modified nucleotides and oligonucleotides. HMT photoaddition shows a very high preference for uracil residues. However, important differences in HMT photoreactivity are observed for various U sites of the tRNA/sup Phe/ molecule. Reactivity of specific bases has been correlated with partial melting of the molecule. Data available so far indicate a strong preference of the photo-reactive probe for a "loose" helical conformation as compared with a tight helix, whereas a random coil appears poorly reactive. (JMT)

8365 **Dependence of 4'-(hydroxymethyl)-4,5',8-trimethylpsoralen photoaddition on the conformation of ribonucleic acid.** Thompson, J.F. (Univ. of California, Berkeley); Bachellerie, J.P.; Hall, K.; Hearst, J.E. *Biochemistry;* **21**: No. 6, 1363-1368(16 Mar 1982).

The photoaddition of 4'-(hydroxymethyl)-4,5',8-trimethylpsoralen (HMT) to different conformational states of RNA was studied. Poly(U), poly(A,U) (random copolymer), poly(A-U) (alternating copolymer), poly(A)-poly(U) (double stranded), and poly(U)-poly(A)-poly(U) (triple stranded) were reacted with HMT at differ-

ent temperatures and salt concentrations. The conformation of the polymers was monitored by UV absorption and circular dichroism. It was found that the rate of HMT photoaddition changed dramatically at structural transitions in the RNA. The alternating copolymer poly(A-U) was found to have the highest rate of addition. Low salt and temperature produced maximal incorporation.

8366 **Reexamination of the binding site for pyridoxal 5'-phosphate in ribulosebisphosphate carboxylase/oxygenase from Rhodospirillum rubrum.** Herndon, C.S.; Norton, I.L.; Hartman, F.C. (Oak Ridge National Lab., TN). *Biochemistry;* **21**: No. 6, 1380-1385(16 Mar 1982). Contract W-7405-ENG-26.

The high specificity of pyridoxal 5'-phosphate (PLP) for an essential lysyl residue of ribulosebisphosphate carboxylase/oxygenase was confirmed, but half-of-sites reactivity was not observed. Subsequent to reduction with [^{3}H]borohydride and tryptic digestion of the enzyme inactivated by PLP, the sole labeled peptide was purified by successive chromatography on DEAE-cellulose, SP-Sephadex, and Sephadex G-25. The peptide, recovered in good yield, appeared essentially homogeneous by amino acid analysis, peptide mapping, and sequencing. Automated Edman degradation established the peptide's sequence as Val-Leu-Gly-Arg-Pro-Glu-Val-Asp-Gly-Gly-Leu-Val-Val-Gly-Thr-Ile-Ile-(PLP)Lys-Pro-Lys instead of Ala-Leu-Gly-Arg-Pro-Glu-Val-Asp-(PLP)Lys-Gly-Thr-Leu-Val-Ile-Lys. The sequence -Ile-Lys-Pro-Lys- in the former is identical with that encompassing Lys-175 in the carboxylase/oxygenase from spinach, which reacts preferentially with PLP and two other affinity labels. This finding of homology greatly strengthens the supposition that Lys-175 in the spinach enzyme and the corresponding lysyl residue in the Rhodospirillum rubrum enzyme are active-site residues and furthermore increases the likelihood of their functionality in catalysis. (JMT)

8367 **Synthesis and solution conformation of the type 2 blood group oligosaccharide αLFuc(1 → 2)βDGal(1 → 4)βDGlcNAc.** Rosevear, P.R. (Michigan State Univ., East Lansing); Nunez, H.A.; Barker, R. *Biochemistry;* **21**: No. 6, 1421-1431(16 Mar 1982).

Partially purified glycosyltransferases and chemically synthesized sugar nucleotides have been used to prepare a number of oligosaccharides related to the type 2 (human) blood group (H) substance. The following oligosaccharides were prepared and purified by ion-exchange and gel-filtration chromatography: αLFuc(1→2)-βDGal(1→4)βDGlcNAc-hexanolamine, αLFuc(1→2)βD[1-^{13}C]Gal(1→4)βDGlcNAc-hexanolamine, αL[1-^{13}C]Fuc(1→2)βD[1-^{13}C]Gal(1→4)βDGlcNAc-hexanolamine, αL[1-^{13}C]-Fuc(1→2)βD[1-^{13}C]Gal(1→4)βDGlcNAc, αLFuc(1→2)βD-[1-^{13}C]Gal(1→4)βDGlcNAc, αL[1-^{13}C]Fuc(1→2)βD[1-^{13}C]-Gal(1→4)βDGlc, αLFuc(1→2)βD[1-^{13}C]Gal-hexanolamine, αL[1-^{13}C]Fuc(1→2)βD[1-^{13}C]Gal-ethanol, αLFuc(1→2)βD-[1-^{13}C]Gal-ethanol, αL[1-^{13}C]Fuc(1→2)βDGal-ethanol and αLFuc(1→2)βD[2-^{13}C]Gal-ethanol. Specific ^{13}C enrichment and comparison with ^{13}C-enriched model compounds allowed unambiguous assignment of ^{13}C resonances. Fucosylation at O2 of βDGal(1→4)βDGlcNAc-hexanolamine caused a 5.6 ppm downfield shift of the C2 resonance of Gal. Fucosylation of the disaccharide βDGal(1→4)DGlcNAc resulted in a similar pattern of chemical shift changes. Interresidue coupling constants (^{3}J/sub C1-C1'/ ≃ 1.5 Hz observed as line broadening, ^{3}J/sub H1-C2'/ ≃ 3.2 Hz, ^{3}J/sub C1'-C3"/ ≃ 0 Hz, ^{3}J/sub C1'-C5"/ ≃ 1.0 Hz observed as line broadening, and ^{2}J/sub C1'-C4"/ ≃ 1.5 Hz) in the enriched oligosaccharides allowed estimation of the most abundant conformer for the Phi and Psi torsion angles in the βDGal(1→4)GlcNAc (Phi' ≃ 60° and Psi' ≃ 15°) and αLFuc(1→2)DGal(Phi ≃ 55° and Psi ≃ 0°) glycosidic linkages of the trisaccharide. (JMT)

8368 **New prodrugs based on phospholipid-nucleoside conjugates.** MacCoss, M. (to Dept. of Energy). US Patent Application 345,442. 3 Feb 1982. 22p. Contract W-31-109-ENG-38.

A method is described for the preparation of defined, isomerically pure phospholipid-nucleoside conjugates as a prodrug in which the drug (araC) is attached to the phospholipid by a monophosphate linkage. Key intermediates in the process involve selective blocking and deblocking of the nucleoside derivative. These particular monophosphate-linked derivatives represent a new class of prodrug, which are useful by themselves or in combination with diphosphate linked derivatives. Several new compositions involving diphosphate linked derivatives are described in which the products are isomerically pure and having defined fatty acid chain lengths.

8369 **Histone turnover within nonproliferating cells.** Commerford, S.L.; Carsten, A.L.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: 1163-1165(Feb 1982). Contract AC02-76CH00016.

The turnover of DNA and histones in the livers and brains of mice has been determined. These mice had been exposed to constant levels of tritiated water from conception until they were 8 months old. At this point, exposure to tritium was discontinued, and the tritium remaining in DNA and histones was measured at various intervals afterward. The half-lives calculated for these components (with 95% confidence limits given in parentheses) were 117 (85 to 188) days for liver histone, 318 (241 to 466) days for liver DNA, 159 (129 to 208) days for brain histone and 593 (376 to 1406) days for brain DNA. The difference between histone and DNA turnover is statistically significant for both tissues and indicates that histone turnover within tissues cannot be solely accounted for by cell turnover within the tissue but also must include histone turnover within living cells. The half-life of histone within cells is estimated to be 117 (88 to 178) days in liver and 223 (187 to 277) days in brain.

8370 **Properties of native and immobilised preparations of β-D-glucosidase from Aspergillus niger.** Woodward, J.; Wohlpart, D.L. (Oak Ridge National Lab., TN). *Journal of Chemical Technology and Biotechnology;* **32**: 547-552(1982). Contract W-7405-ENG-26.

The enzyme β-D-glucosidase from Aspergillus niger has been immobilised through its carbohydrate moiety on concanavalin A-Sepharose and on cyanogen bromide-activated Sepharose after aminoalkylation of the carbohydrate side chains of the enzyme. For comparison, the enzyme was also immobilised on microcrystalline cellulose through its protein moiety. High retention of activity and a decrease in K/sub m/ and V/sub max/ were observed when β-D-glucosidase was immobilised by these methods. An increase in the thermal stability of the immobilised β-D-glucosidase preparations over the soluble enzyme was achieved if it was treated with glutaraldehyde before its adsorption on concanavalin A-Sepharose or if the enzyme immobilised on cyanogen bromide-activated Sepharose was subsequently treated with glutaralydehyde. Treatment of β-D-glucosidase immobilised on microcrystalline cellulose with glutaraldehyde hardy increased its thermal stability over the soluble enzyme.

8371 **Carotenoid and cytochrome b 559 reactions in photosystem II in the presence of tetraphenylboron.** Velthuys, B.R. *FEBS (Federation of European Biochemical Societies) Letters;* **126**: No. 2, vp(Apr 1981). Contract AC02-76ER03326.

Measurements of flash-illuminated chloroplasts are described that indicate that the donor side of PS II acts, as required, as a 2-electron acceptor in the oxidation of phi$_4$B$^-$ (oxidation does not occur with every flash). The reactions involve cyctochrome b 559, which appears to be alternately oxidized and reduced by PS II in the presence of phi$_4$B$^-$, and a carotenoid. The carotenoid is appreciably oxidized during the reduction of cytochrome b 559.

8372 **Photosynthetic electron transport in the bundle sheath of maize.** Leegood, R.C. (The Univ., Sheffield, England, United Kingdom); Crowther, D.; Walker, D.A.; Hind, G. *FEBS (Federation of European Biochemical Societies) Letters;* **126**: No. 1, 89-92(Apr 1981).

In this letter, flash spectrophotometric studies are described which indicate that photosystem II activity is inadequate to poise cyclic electron flow in bundle sheaths of maize, and that malate decarboxylation supplies the necessary electrons.

8373 **Maleylacetone cis-trans isomerase: formation of an N-ethylmaleimide-labeled enzyme only during the slow phase of the biphasic inhibition reaction.** Lin, M.; Seltzer, S. (Brookhaven National Lab., Upton, NY). *FEBS (Federation of European Biochemical Societies) Letters;* **124**: No. 2, 169-172(Feb 1981).

Maleylacetone cis-trans isomerase for Vibrio 01 has been reported to be irreversibly inactivated by N-ethylmaleimide (NEM) and consequently to have an important thiol group. This paper demonstrates that the kinetics of NEM-inactiviation is biphasic. Covalent attachment of the inhibitor to the only cysteinyl thiol occurs in the slower phase. No covalent attachment of NEM in the rapid phase can be detected. (KRM)

8374 **Stereoelectronic properties of photosynthetic and related systems - IX. Ab initio quantum mechanical characterization of the electronic structure and spectrum of the bacteriochlorophyllide a anion radical.** Petke, J.D. (Univ. of Kansas, Lawrence); Maggiora, G.M.; Shipman, L.L.; Christoffersen, R.E. *Photochemistry and Photobiology;* **33**: 663-671(1981).

Ab initio configuration interaction wavefunctions and energies are reported for 19 doublet states of the anion radical of ethyl bacteriochlorophyllide a (Et-BChl a^-), and are employed in a resolution of the electronic absorption spectrum, as well as in a comparison with a previously reported study of the electronic states and spectrum of the anion radical of ethyl bacteriopheophorbide a (Et-BPheo a^-). The lowest two excited doublet states, D_1 and D_2, of Et-BChl a^- are found to be approximately degenerate and are predicted to contribute to the experimentally observed absorption at 10000 cm^{-1}. In contrast, the $D_3 \leftarrow D_0$ transition in Et-BPheo a^- is predicted to contribute to the 11000 cm^{-1} absorption, while the $D_1 \leftarrow D_0$ transition appears at approximately 8600 cm^{-1} with a low oscillator strength ($f = 0.002$). The prominent visible absorption at $\sim$15700 cm^{-1} in both molecules is found to be due to the $D_4 \leftarrow D_0$ transition. The ground state spin densities of the two molecules are similar, with the minor difference of somewhat less spin located on the methine carbon atoms of Et-BChl a^- compared with Et-BPheo a^-.

8375 **Reappraisal of the role of the low potential c-type cytochrome (cytochrome c-552) in NADH-dependent nitrite reduction and its relationship with a co-purified NADH oxidase in Escherichia coli K-12.** Liu, M.C. (Univ. of Georgia, Athens); Peck, H.D. Jr.; Abou-Jaoude, A.; Chippaux, M.; LeGall, J. *FEMS Microbiology Letters;* **10**: 333-337(1981). Contract AS09-79ER10499.

In the present study, the cytochrome c-552 has been purified to homogeneity, some of its properties characterized and its role in the NADH-dependent nitrite reduction, which also involves a co-purified NADH oxidase, reevaluated. An electron transport pathway from NADH to nitrite involving both the cytochrome c-552 and the NADH oxidase is proposed.

8376 **Limited proteolysis by macrophage elastase inactivities human αY-proteinase inhibitor.** Banda, M.J.; Clark, E.J.; Werb, Z. (Univ. of California, San Francisco). *Journal of Experimental Medicine;* **152**: 1563-1570(Dec 1980). Contract AC03-76SF01012.

Ever since the initial description of α_1-proteinase inhibitor (α_1PI), the role of this plasma glycoprotein and its allelic polymorphism in disease and in healthy physiology has been the subject of much investigation, α_1PI inactivates a number of serine proteinases, including granulocyte elastase, and thus affords protection from the connective tissue degradation mediated by this class of proteinases. Because an imbalance in the ratio between α_1PI and proteinase may contribute to the development of destructive lung diseases, proteinases have been implicated in the pathogenesis of pulmonary emphysema. Both macrophages and polymorphonuclear leukocytes have been implicated in disruption of the α_1PI-proteinase balance. In this report, a new mechanism for alteration of the α_1PI-proteinase balance is demonstrated. It was found that the purified form of macrophage elastase catalytically degrades and inactivates α_1PI so that it no longer inhibits the elastinolytic activity of granulocyte elastase.

5503 Cytology

REFER ALSO TO CITATION(S) 8441

8377 **Receptor clustering on a cell surface. III. Theory of receptor cross-linking by multivalent ligands: description by ligand states.** Perelson, A.S. (Brown Univ., Providence, RI). *Mathematical Biosciences;* **53**: 1-39(1981).

The interaction of multivalent ligand with cell surface receptors is the first step in triggering a number of biological responses. A mathematical model for the binding of a multivalent ligand containing v identical reactive sites, to monovalent or multivalent cell surface receptors is presented and analyzed. The initial binding of such ligands to a cell is followed by futher reactions on the surface which cross-link receptors and lead to the formation of ligand-receptor clusters. By introducing the concept of an effective valence for the ligand, which is the number of reactive groups that can simultaneously bind to surface receptors, one can take into account steric hindrance and the inability of some ligand determinants to participate in cross-linking reactions because they are oriented incorrectly. When the ligand's effective valence is greater than two, a number of different criteria can be used to measure receptor clustering. The dependence of these aggregation measures on ligand and monovalent hapten concentration is studied. A number of theorems are proven about the general shape and characteristics of cross-linking curves. As an application, the theory is used to interpret previously published experiments on the release of histamine by basophils. (KRM)

8378 **Polyethylene glycol-induced fusion of two-cell mouse embryo blastomeres.** Spindle, A. (Univ. of California, San Francisco). *Experimental Cell Research;* **131**: 465-470(1981). Contract AC03-76SF01012.

Polyethylene glycol (PEG) was found to be an effective fusion-inducing agent for early mouse embryo blastomeres. A brief exposure of zona-intact 2-cell embryos to 40% PEG induced fusion of blastomeres in > 80% of embryos, and the treatment did not interfere with subsequent development of embryos to the blastocyst stage.

5504 Genetics

8379 **Induced gene and chromosome mutants.** Nilan, R.A. (Washington State Univ., Pullman). *Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences;* **292**: 457-466(1981).

This paper considers the current and future impact of induced gene and chromosome mutants on plant improvement. It also examines the impact of induced mutants on breeding research, especially towards providing new knowledge about the genetics, physiology, anatomy and biochemistry of cellular processes that produce all the traits so necessary for successful cultivars now and in the future.

5505 Metabolism

8380 (KFK-AFR—003, pp 37-38) **Interchangeability of K, Rb, and Cs in blood platelets.** Kiem, J.; Kasperek, K.; Iyengar, G.V.; Wang, X.Y.; Feinendegen, L.E. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

5506 Medicine

REFER ALSO TO CITATION(S) 8229, 8368, 8722

8381 **(GSF-B—1108) Experimental tumor therapy.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1980. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82751045.

This study was concentrated on the investigation of practically oriented problems of tumour therapy, under the application of possibly differing experimental test subjects, ranging from cell cultures to the living animal. The development of the test systems was advanced and some systems were replaced by new ones. An enrichment of great significance is also the fibrosarcoma SSK-2 of the C3H mouse, whose cells form colonies with an exploitation of about 50% when the explant is transferred directly to the cell culture. The subject matter of the experiments ranged from the effect of irradiation on cells in vitro to the proliferation kinetics of human tumours under treatment. As in the last year the main significance and attention was attributed to the analysis of time dependency in radiotherapy. The second main point were investigations on the interaction of chemotherapy and radiotherapy, supplemented by experiments to the time dependency in chemotherapy.

8382 **(IKE—6-122) Oxygen diffusion and oxygen effect in tumor tissue.** Eissa, H.M.; Hehn, G. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Jun 1979. 141p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750439.

The diffusion of oxygen in tumor cords of bronchus carcinoma of the lung have been studied with refined computer methods for solving the diffusion equation in axis symmetric tumor structures. In this tumor configuration we may find three different regions consisting of euoxic cells, hypoxic tumor cells and necrotic parts. In the case of oxygen supply from a capillary inside a cylinder of tumor tissue with radius 200 μm or in a tumor cord of radius 300 μm with oxygen supply by capillaries outside, we get a relation of well oxygenated cells to hypoxic cells approximately as 1:8 or as 1:1.1 respectively. Of course most of the tumor cords observed in histological slices have smaller diameters, so that an average of approximately 20% hypoxic cells can be assumed. Based on the work of Ardenne, the diffusion of oxygen and glucose in a tumor of type DS-carcinosarcom has been investigated in both intact tumor and tumor treated with ionizing radiation. We can show that a strong reoxygenation effect takes place in that the well supplied regions may increase in some tumor configurations up to a factor of four by volume. The biological consequences of the oxygen pressure determined in tumor cells are discussed in detail. The investigation of oxygen diffusion in the intercapillary tumor region should give a quantitative physical basis for considering the oxygen effect with the aim to explain the advantages of neutron therapy against conventional radiotherapy.

8383 **(KFK-AFR—003, pp 33-34) NAA of human and animal tissues after application of metal implants.** Michel, R.; Hofmann, J.; Zilkens, J.; Loeer, F. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8384 **(KFK-AFR—003, pp 35-36) Application of INAA to investigate healing of wounds: Checking the method of analysis for methodical errors and experiments on healing during the first two weeks.** Bereznai, T.; Lux, F.; Reher, J.; Ghermai, A.; Bluemel, G. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8385 **(PB—82-206947) The preparation of 131I-labelled oestrone derivatives.** Ozker, K.; East, B.W.; Harris, I.A.; Boddy, K. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). Mar 1977. 22p. NTIS, PC A02/MF A01.

The labelled compound has been prepared for use in the external scanning of the mammary glands for tumors and malignancies and as a possible therapeutic agent. Properties of the oestrogen analogue are only slightly altered by specific labelling with iodine-131. The cytotoxic effect of the beta and gamma emissions on malignant cells may make the ^{131}I labelled compound useful as a possible therapeutic agent for the incorporation of methylated derivations of oestrone into the rapidly proliferating cells of carcinomatous mammary glands and metastases.

8386 **(PB—82-217175) Medical Physics Data Book.** Padikal, T.N.; Fivozinsky, S.P. (National Bureau of Standards, Washington, DC (USA)). Mar 1982. 125p. NTIS, PC A06/MF A01.

The Medical Physics Data Book is a collection of physical and chemical data useful in medical physics. The information has been extracted from other published sources. The handbook is divided into five sections: General Physics, Nuclear Medicine, Diagnostic Radiology, Radiation Therapy, and Non-ionizing Radiation. Carried out by the Medical Physics Data Group of the American Association of Physicists in Medicine, this compilation is meant to serve as a handy reference to the numerical data needed by the practicing medical physicist.

8387 **(JPRS—82060) USSR report: Life Sciences Biomedical and Behavioral Sciences No. 23.** (Joint Publications Research Service, Washington, DC (USA)). 25 Oct 1982. Translation of various articles. 137p. NTIS. Order Number DE83900408.

Portions of document are illegible.

Translations of Russian articles are presented in the areas of biochemistry, biotechnology, epidemiology, genetics, laser effects, marine mammals, medical demography, clinical medicine, microbiology, and psychology. (ACR)

8388 **Lymphoscintigraphy with Tc-99m-labeled dextran.** Henze, E.; Schelbert, H.R.; Collins, J.D.; Najafi, A.; Barrio, J.R.; Bennett, L.R. (UCLA School of Medicine, Los Angeles, CA). *Journal of Nuclear Medicine;* **23**: No. 10, 923-929(Oct 1982).

Current agents for lymphoscintigraphy have limitations because of slow migration of the colloidal tracer from the injection site and the unknown effect of phagocytosis on the removal of the labelled particles. The usefulness of Tc-99m dextran (TcDx) with a molecular weight of 110,000 has been tested for lymphoscintigraphy. Computer-assisted dynamic imaging and serial blood sampling in 13 dog experiments demonstrated that the tracer cleared only by lymph drainage from an interstitial injection site. Following interdigital injection of 1.0 ml (0.5-5.0 mCi), TcDx reached the knee or elbow lymph nodes in 12.4 +/- 6.5 (1 s.d.) sec, and the inguinal or axillary lymph nodes in 98.0 +/- 42.3 sec. It cleared from the injection site with a half-time of 31.5 min. In a dog with surgically induced lymphedema, tracer migration was markedly delayed in the edematous leg and the radionuclide lymphoscintigram resembled the contrast lymphangiogram. Initial studies in man yielded high-quality radionuclide lymphograms of the leg, and the pelvic and paraaortic lymph nodes. We concluded that TcDx is very promising for lymphoscintigraphy.

8389 **Modifiers of radiation response in tumor therapy: strategies and expectations.** Elkind, M.M. *International Journal of Radiation Oncology, Biology and Physics;* **8**: No. 1, 89-100(Jan 1982). Contract W-31-109-ENG-38.

The administration of two (or more) cytotoxic agents to widen the differential between the responses of tumor and normal tissues depends upon the biological properties of the agents in the cells and tissues, their interactive potential, and the strategy employed in their administration. Assuming that one agent is ionizing radiation, and considering response modification in broad terms, the qualitative features of various strategies are developed for physical as well as chemical modifies. The heterogeneity of human tumor cells and the compensatory mechanisms of normal tissues following injury are identified as topical areas requiring sustained research effort. Finally, estimates are developed for the degree of improvement required from a response modifier to effect significant improvements in tumor cure rates.

8390 **Particle radiation therapy: the first forty years.** Castro, J.R. (Univ. of California, San Francisco). *Seminars in Oncology;* **8**: No. 1, 103-109(Mar 1981). Contract W-7405-ENG-48.

Particle radiotherapy has been utilized with increasing frequency but its role in clinical radiotherapy is still unsettled. This paper reviews clinical results with charged particle irradiation which provides improved dose distribution with sparing of adjacent

critical structures. The effectiveness of fast neutrons, pi mesons, and ion beams are discussed. The debate in radiotherapy concerning the importance of the oxygen effect suggests that particle radiotherapy may offer a significant improvement in view of their potential for killing hypoxic tumor cells.(KRM)

5507 Microbiology

REFER ALSO TO CITATION(S) 8362, 8370, 8375, 8387, 8433

8391 Hydrogen cycling as a general mechanism for energy coupling in the sulfate-reducing bacteria, Desulfovibrio sp. Odom, J.M.; Peck, H.D. Jr. (Univ. of Georgia, Athens). *FEMS Microbiology Letters;* **12**: 47-50(1981). Contract AS09-79ER10499.

Direct evidence is presented for a requirement of periplasmic hydrogenase and cytochrome c_3 (M/sub r/ = 13,000) for the oxidation of lactate with sulfate in spheroplasts of D. gigas, and hydrogen cycling with vectorial electron transfer is proposed as a general mechanism for energy coupling in the sulfate-reducing bacteria.

5508 Morphology

REFER ALSO TO CITATION(S) 8387

5509 Pathology

8392 Diffuse interstitial pulmonary fibrosis: pulmonary fibrosis in mice induced by treatment with butylated hydroxytoluene and oxygen. Haschek, W.M. (Oak Ridge National Lab., TN); Brody, A.R.; Klein-Szanto, A.J.P.; Witschi, H. *American Journal of Pathology;* **105**: No. 3, 333-335(Dec 1981). Contract W-7405-ENG-26.

It is proposed that the pulmonary fibrosis induced in mice by treatment with BHT and oxygen is a good experimental model for human pulmonary fibrosis. The mechanism of synergistic and additive effects of various agents on pulmonary injury and the epithelial mesenchymal interactions occurring during the early and late phases of lung repair could be studied. This model could be used for study of the effects of various concentrations of oxygen on diffusely damaged lung and assessment of the efficacy of drugs in preventing or resolving excessive collagen accumulation in lung. In addition, the relationship between pulmonary fibrosis and emphysema could be studied.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 8446, 8447

8393 Formation of hybrid phycobilisomes by association of phycobiliproteins from Nostoc and Fremyella. Canaani, O.; Gantt, E. (Smithsonian Inst., Rockville, MD). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: No. 17, 5277-5281(Sep 1982).

Formation of phycobilisomes has been accomplished in vitro from isolated phycobiliprotein fraction obtained from the same blue-green alga (intrageneric) and from different blue-green algae (intergeneric). Phycobilisomes, which are supramolecular complexes of phycobiliproteins, serve as major light-harvesting antennae for photosynthesis in blue-green and red algae. Intrageneric association into energetically functional phycobilisomes, previously reported to occur with Nostoc sp. allophycocyanin and phycoerythrin-phycocyanin complexes has been obtained with Fremyella diplosiphon. By their spectral propeties (absorption, fluorescence excitation, and emission) and electron microscopic images, the native and in vitro-associated phycobilisomes were virtually indistinguishable. Intergeneic phycobilisomes have been produced from allophycocyanin of Nostoc sp. strain Mac, and phycoerythrin-phycocyanin of F. diplosiphon, as well as from the reverse mixtures. Phycobilisomes of Nostoc and Fremyella, analyzed by $NaDodSO_4$/polyacrylamide gel electrophoresis, possessed a number of polypeptides having similar molecular weights: the usual α- and β-phycobilin-containing polypeptides of M/sub r/ 15,000-22,000, a faint band at M/sub r/ ca. 95,000, and a prominent band at M/sub r/ ca. 31,000. The M/sub r/ 31,000 polypeptide is assumed to provide the recognition site for attachment of the phycoerythrin-phycocyanin complexes with the allophycocyanin core. In vitro association was not obtained between allophycocyanin from Nostoc and phycoerythrin-phycocyanin complexes from Phormidium persicinum or Porphyridium sordidum.

8394 The relationship between the Gompertz constant and maximum potential lifespan: its relevance to theories of aging. Rosen, P.; Woodhead, A.D.; Thompson, K.H. (Brookhaven National Laboratory, Upton, NY). *Experimental Gerontology;* **16**: No. 2, 131-135(1981).

A correlation between the two aging parameters, the Gompertz constant, α and the maximum potential lifespan T is obtained. The product of α and T lies between 2 and 12 for mammals which have ceased to grow in their adult years, fish which continue to grow throughout life and rotifers, which have a constant number of cells. Since T is related to the metabolic rate, M, as $M^{-3/4}$, then α must be related to the metabolic rate as $M^{+3/4}$. It is suggested that somatic mutations play a lesser role than metabolism in aging.

8395 Relative effectiveness of vitamin D metabolites in increasing bone mineral solubility. Somerman, M.J.; Neuman, W.F. (Univ. of Rochester Medical Center, NY). *Calcified Tissue International;* **33**: 159-165(1981). Contract AC02-76EV03490.

Weanling rats were given a vitamin D-deficient diet containing 1.4% calcium and 1.0% phosphorus. After 4 weeks these deficient animals were injected for 7 days with selected doses of one of the following vitamin D metabolites: $25(OH)D_3$, $1,25(OH)_2D_3$, $24,25(OH)_2D_3$, $25,26(OH)_2D_3$ or the ethanol vehicle. After 5 weeks on this diet the vitamin D-deficient rats had low levels of serum calcium (1.41 mM) and decreased mineral solubility when compared to the vitamin D-replete group. The apparent solubility of the bone mineral increased toward the vitamin D-replete level in calvaria from vitamin D metabolite-treated rats. However, these changes did not directly reflect the alterations in the level of serum calcium.

5520 Public Health

REFER ALSO TO CITATION(S) 8399, 8440, 8444, 8454

8396 Mortality and air pollution: lessons from statistics. Lipfert, F.W. (Brookhaven National Lab., Upton, NY). *Science of the Total Environment;* **23**: 175-184(1982). Contract AC02-76CH00016.

This paper reviews cross sectional studies which attempt to link persistent geographic differences in mortality rates with air pollution. Some early studies are mentioned and detailed results are given for seven major contemporary studies, two of which are still in the publication process. Differences among the studies are discussed wth regard to statistical techniques, trends in the results over time (1959 to 1974), and interpretation and use of the results. The analysis concludes that there are far too many problems with this technique to allow causality to be firmly established, and thus the results should not be used for cost benefit or policy analysis.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 7172, 7776, 7853, 8029, 8056, 8357

8397 (KFK-AFR—003, pp 39) Variations in trace element concentrations in normally cooked vegetables, determined by means of activation analysis. Schelenz, R. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8398 **Agriculture, rural energy and development.** Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981). 565p. (CONF-8010299—). University of Michigan, Administration Division of Research, Ann Arbor, MI 48109 $15.00.

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Papers presented at this symposium are included in this volume. Topics discussed are: rural energy; perspectives in agriculture and rural development; some general considerations in rural energy technology development; technology flows in rural energy; social dimensions of appropriate technology; women and rural energy; case studies in renewable energy technology development; agricultural technology; and case studies in agriculatural technology and energy development. Separate abstracts have been prepared for individual papers for inclusion in the Energy Data Base. (RJC)

8399 **Development and various dimensions of appropriate technology.** Oyeka, I.C.A. (Univ. of Nigeria, Nsukka). pp 1-9 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Concepts of appropriate technology in developing countries are defined in this paper. The functional relevance of a given technology in meeting a community's commonly identified development needs in agriculture, health, and energy in real life situations is discussed. (RJC)

8400 **Energy use in agriculture: Third World lessons for the United States.** Perelman, M. (California State Univ., Chico). pp 138-150 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

The present condition of agriculture in the US is discussed. The production of 1 calorie of food requires more than 10 calories of nonrenewable energy; about 30 pounds of soil are eroded for every pound of food delivered. It is a myth that American agricultural technology is efficient. The techniques in vogue are less labor intensive, but the net efficiency is very low. Net farm income is highest for the $20,000 to $40,000 gross sales farm and lowest for the $200,000 + gross sales farm. The state and fate of labor and the hidden costs in agriculture are discussed. The author concludes that developing countries can ill afford to adopt a technology such as is in use in the USA. (RJC)

8401 **Technology without Bacon, Newton or Einstein: an inventory of indigenous knowledge and techniques in food processing.** Maloney, T.J. (Southern Illinois Univ., Edwardsville). pp 308-312 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper describes a survey of the ethnographic-ethnological literature on postharvest, nonculinary processing of foods. Useful material for possible application in developing nations was obtained from the Human Relations Area Files (HRAF). The various ways the data extracted from HRAF can be classified as outlined. (RJC)

8402 **Utilization of silt aquifers.** Drake, L.D. (Univ. of Iowa, Iowa City). pp 452-464 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Most shallow well systems depend upon geologic formations of sands, gravels, or fractured rock to supply an adequate flow of groundwater. Large volumes of groundwater also flow through shallow silt formations but usually remain untapped because the silts clog sandpoints, collapse or flow into open wells and thus yield water too slowly to pumps. However, these sediments can be utilized for water supplies by digging a narrow trench below the water table, perpendicular to the flow of groundwater, and backfilling the trench with sand. As the sand is emplaced, gallery tubes, tiles, or sandpoints are installed to direct the groundwater to a pump. Three silt aquifer systems have been built in eastern Iowa and have been producing hundreds to thousands of liters per day during the past 5 to 7 years. Five small test installations were also evaluated, which have produced hundreds of liters per day over a few weeks. A variety of pumping methods, trench configurations, and capping methods have been studied. The volume of sand fill in the trenches has ranged from $2m^3$ in the smallest test site to $120m^3$ in the largest producing well. The watersheds supplying the groundwater are small, ranging from 2 to 43 hectares, and most are in upland settings. The author also discusses the application of this system in developing nations. (RJC)

8403 **Question of technology in agricultural development in India: a regional study.** Kundu, A.; Raza, M. (Univ. of Pennsylvania, Philadelphia). pp 504-526 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper describes a regional study of the development of agriculture in India since independence. The subject is discussed under the following headings: the setting, scope and geographical coverage of the present study, agricultural regions in India, patterns of regional disparities, an analysis of interdependencies, and generalizations. (RJC)

8404 **Appropriate irrigation technology for Nigeria's north-eastern sub-Sahelian zone.** Adeniji, F.A. (Univ. of Maiduguri, Borno State, Nigeria). pp 528-539 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

This paper describes the rapid increase in irrigation for agriculture in Nigeria and the use and type of common irrigation systems. A case study is presented which discusses the extent and location of the study area and the agricultural resources there. The existing irrigation technology with reference to water resources development, irrigation systems, and land and water allocations is presented. The recommended technology concerning irrigation is also given. (RJC)

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 8232, 8315, 8316, 8349, 8382, 8382, 8446, 8447, 8723, 8724

8405 **(AD-A—114739/6) A summary report on the solubility of depleted U(3)O(8) in simulated lung fluid, Ringer's solution and Ringer's lactate.** Butler, W.D. (Frank J. Seiler Research Lab., United States Air Force Academy, CO (USA)). Aug 1981. 23p. NTIS, PC A02/MF A01.

Arguments have arisen over the solubility of Depleted U3O8 in lung and other interstitial fluids. Knowing that Depleted U3O8 was insoluble in water, this study was undertaken to determine the relative solubilities, if any, in biological fluids. Results show very low solubility (less than 12%) for the biological fluids studied.

8406 **(DOE/EV/01643—145) Progress report, January 1982-September 1982.** Van Middlesworth, L. (Tennessee Univ., Memphis (USA). Dept. of Physiology and Biophysics). 1982. Contract AS05-76EV01643. 41p. (ORO—1643-145). NTIS, PC A03/MF A01. Order Number DE83002963.

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Progress is reported in the following research areas: (1) radioactivity in thyroid glands of grazing animals; and (2) iodine metabolism of experimental animals. (ACR)

8407 **(GSF-S—710) Radiation exposure and radiation risk of the population.** Jacobi, W.; Paretzke, H.G.; Ehling, U.H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Feb 1981. 265p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE82750679.

The major scientifically founded results concerning the assessment of the radiation exposure and the analysis and evaluation of the radiationhazards for the population, particularly in the range of low doses, are presented. As to the risk analysis special attention is paid to the rays with low ionization density (X-, γ-, β- and electronrays). Contents: 1) Detailed survey of the results and conclusions; 2) Data on the radiation load of the population; 3) Results to epidemiological questioning on the risk of cancer; 4) Genetical radiation hazards of the population. For quantification purposes of the risk of cancer by γ-radiation the observations with the a-bomb survivors in Japan are taken as a basis, as the available dosimetrical data have to be revised. Appendices: 1) German translation of the UNSCEAR-Report (1977); 2) BEIR-Report (1980); 3) Comments from the SSK on the comparability of the risks of natural-artificial radiation exposure; 4) Comments from the SSK on the importance of synergistical influences for the radiation protection (23.9.1977).

8408 **(NUREG—0914) Radiological containment handbook.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1982. 122p. NTIS - GPO $6.00. Order Number DE83900480.

The purpose of this NUREG is to be used as a reference text. It is meant to be used by the working personnel as a guide for using temporary radiological containments. The installing group and health physics group may vary among organizations but responsibilities and duties will not change. It covers installation and inspection containments; working and operating guidelines; operating requirement; emergency procedures; and removal of containments.

8409 **(ORNL/TM—8281) Eighteenth nuclear accident dosimetry intercomparison study: August 10-14, 1981.** Swaja, R.E.; Sims, C.S.; Greene, R.T. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 71p. NTIS, PC A04/MF A01. Order Number DE83003384.

Portions of document are illegible. Printed copy available until stock is exhausted.

The Eighteenth Nuclear Accident Dosimetry Intercomparison Study was conducted August 10-14, 1981, at the Oak Ridge National Laboratory. Nuclear criticality accidents with three different neutron and gamma ray energy spectra were simulated by operating the Health Physics Research Reactor in the pulse mode. Participants from 13 organizations exposed dosimeters set up as area monitors and mounted on phantoms for personnel monitoring. Analysis of experimental results showed that about 56% of the reported neutron doses measured using foil activation, thermoluminescent, or sodium activation methods and about 53% of the gamma doses measured using thermoluminescent methods met nuclear accident dosimetry guidelines which suggest accuracies of +- 25% for neutron dose and +- 20% for gamma dose. The greatest difficulties in measuring accident doses occurred in radiation fields with large fractions of low energy neutrons and a high gamma component (> 40%). Results of this study indicate that continued accident dosimetry intercomparisons are necessary to test dosimetry systems and training programs are needed to improve the technical competence of evaluating personnel.

8410 **(PB—82-210956) Liquid radiochromic dosimetry. Final report.** Rativanich, N.; Radak, B.B.; Miller, A.; Uribe, R.M.; McLaughlin, W.L. (National Bureau of Standards, Washington, DC (USA)). 1981. 10p. Pub. in Proceedings of International Meeting on Radiation Processing (3rd),Tokyo, Japan, October 26-30, 1980, paper in Radiation Physics and Chemistry 18, n5-6 p1001-1010 1981.

By strategic combination of weak acid, mild oxidizing agent, and polar organic solvents containing millimolar concentrations of leucocyanides of certain triphenylmethane dyes, fairly broad ranges of absorbed doses of ionizing radiation can be determined.

8411 **(PB—82-215500) Annual report of the Division of Biological Effects, Bureau of Radiological Health, fiscal year 1980, October 1, 1979-September 30, 1980.** (Bureau of Radiological Health, Rockville, MD (USA)). Mar 1982. 97p. NTIS, PC A05/MF A01.

The Division of Biological Effects, Bureau of Radiological Health, plans, conducts, and supports epidemiological and experimental studies of health effects of both ionizing and nonionizing radiation, including x rays, radiopharmaceuticals, microwaves, ultraviolet light and ultrasound. Through intramural and extramural epidemiological studies, laboratory investigations and critical reviews of the literature, the division evaluates research to assess the health effects resulting from exposure to radiation. This report gives an account of work completed and in progress for the period October 1, 1979, through September 30, 1980, in support of health-related radiation research and evaluation, particularly as it concerns the biologic effects of exposure to electronic products.

8412 **(PNL-SA—9529) DOE personnel neutron dosimeter evaluation and upgrading program.** Faust, L.G.; Endres, G.W.R.; Fix, J.J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 7p. (CONF-8106144—11). NTIS, PC A02/MF A01. Order Number DE83002663.

From Health Physics Society annual meeting; Louisville, KY, USA (21 Jun 1981).

A description is given of the program to evaluate personnel neutron dosimeters in use at DOE facilities and to develop into prototype dosimeters concepts potentially capable of increasing the level of performance in personnel neutron dosimetry. The program encompasses tasks to be conducted at several DOE laboratories, some universities, and private companies as well as the US National Bureau of Standards (NBS). The program is scheduled as a two year effort beginning during FY 1981. Program administration involves the coordination of two DOE committees, the DOE program manager, and the lead laboratory. The steering committee was established to provide technical support to the lead laboratory by reviewing the state-of-the-art in neutron dosimetry, identifying promising program concepts, and recommending alternative routes of dosimeter development. The Program Review committee overviews the lead laboratory, including review of proposals for technical content and operational practicality. All recommendations are provided to the DOE program manager for final resolution.

8413 **Permanence of suppression of the primary immune response in rainbow trout, Salmo gairdneri, sublethally exposed to tritiated water during embryogenesis.** Strand, J.A.; Fujihara, M.P.; Poston, T.M.; Abernethy, C.S. (Pacific Northwest Lab., Richland, WA). *Radiation Research;* 91: No. 3, 533-541(Sep 1982).

Previous experiments demonstrated that antibody synthesis in response to a challenge from the bacterium, Flexibacter columnaris, was significantly suppressed in juvenile (5 months) rainbow trout following exposure to tritium at doses as low as 4.0 rad when administered during the first 20 days of embryogenesis. In continuing studies, a secondary challenge to columnaris cells delivered to yearling (17 months) trout was used to test the hypothesis that early embryonic exposure to tritium irradiation (0, 0.04, 0.4, 4.0, and 40.0 rad) resulted in permanent injury to the primary immune process.Results indicated that under the prescribed experimental

conditions, suppression of the primary immune response was permanent; that is, the degree of injury in yearling fish (17 months) equaled or exceeded that found in juvenile fish (5 months). At levels in the range of the maximum permissible concentration, tritium produced measurable, dose-dependent, and irreversible suppression of immune capacity in affected fish. The threshold-free and exponential nature of the dose-response curve suggests extrapolation of effects to even lower exposures.

8414 **Interaction of ^{144}Ce and partial hepatectomy in the production of liver neoplasms in the Chinese hamster.** Brooks, A.L.; Benjamin, S.A.; Jones, R.K.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Radiation Research;* **91**: No. 3, 573-588(Sep 1982).

Chinese hamsters (LF random bred) were injected intraperitoneally with a range of levels of ^{144}Ce-^{144}Pr citrate. After the injection they either had no further treatment or were partially hepatectomized at either 20 days before injection or 20 or 200 days after injection. Control hamsters were subjected to a similar surgical schedule. The average radiation dose of the liver at sacrifice ranged from 15 to 110 Gy and produced from 0.44 to 3.40 metaphase chromosomal aberrations per liver cell. Thus aberration frequency was very high when live tumors were observed. Of the 330 animals injected with ^{144}Ce, 108 developed primary neoplasms in the liver while no liver tumors were observed in 97 control animals. When animals with similar survival and total lifetime dose to the liver were compared, partial hepatectomy performed 20 or 200 days after ^{144}Ce injection significantly increased liver tumor incidence. Partial hepatectomy before ^{144}Ce injection had no effect. Enhanced cell division from partial hepatectomy plays a role in the induction of live neoplasms following low-dose-rate β-γ exposure from the radioisotope ^{144}Ce.

8415 **In vitro quantitation of lethal and physiologic effects of total body irradiation on stromal and hematopoietic stem cells in continuous bone marrow cultures from Rf mice.** Greenberger, J.S. (Havard Medical School, Boston, MA); Eckner, R.J.; Otten, J.A.; Tennant, R.W. *International Journal of Radiation Oncology, Biology and Physics;* **8**: No. 7, 1155-1165(Jul 1982). Contract W-7405-ENG-26.

The effects of in vivo total body irradiation (TBI) and interval from TBI to explant of marrow on: stromal cell proliferation in vitro; stromal cell support of hematopoiesis in continuous bone marrow culture; and generation of WEHI-3 growth factor (GF)-dependent lines of hematopoietic progenitor cells were evaluated. Explant of marrow at 2, 4, 5, or 6 months after single fraction TBI (300-800 rad) was associated with decreased longevity of hemopoiesis and a decrease in the proliferative capacity of fibroblastic adherent-stromal colony forming cells (CFUf) as measured by colony size at 14 days and number of colonies per 10^6 cells plated. In contrast, explant of marrow 8 to 24 months after TBI produced cultures with longevity that was indistinguishable from age-matched control cultures (19-24 weeks). Marrow from irradiated first and second generation recipients of serially transferred marrow demonstrated a similar 7-month in vivo recovery period; however, the plateau maximum duration of hemopoiesis did not return to control levels. Purified stromal cell cultures were prepared by corticosteroid-deprivation of explanted marrow for 28 days and were then engrafted in vitro with marrow from C57BL/6J or RfM/UN mice that had been irradiated 1 month previously. Hemopoiesis in these cultures was restored, and they produced GM-CFUc and granulocytes for 15-24 weeks. Thus, healthy stroma supported growth of recently irradiated hemopoietic cells in vitro. Indirect effects of x-irradiation on hemopoietic stem cells through damage and repair in the stromal cell compartment can be effectively studied with the present bone marrow culture system. (JMT)

8416 **Late effects of heavy charged particles on the fine structure of the mouse coronary artery.** Yang, V.V.; Ainsworth, E.J. (Lawrence Berkeley Lab., CA). *Radiation Research;* **91**: No. 1, 135-144(Jul 1982). Contract W-7405-ENG-48;W-31-109-ENG-38.

A pilot study was conducted to evaluate ultrastructureal changes in the coronary arteries of the B_6CF_1 mouse 15 months after irradiation with photons or heavy charged particles. Irradiations, given at 4 months of age, included single upper-body doses of 1.6 Gy ^{40}Ar, 0.2, 0.4, 0.8, or 3.2 Gy ^{20}Ne, 0.1 or 3.2 Gy ^{12}C, and 1.6, 3.2, or 7.0 Gy ^{60}Co γ. Coronary artery degeneration was found in both irradiated and unirradiated control animals. Radiation appeared to produce more severe degenerative changes than that seen in the age-matched controls. The major changes included medial smooth muscle degeneration, fibrosis, accumulation of debris, and extracellular matrix. On the basis of quantitative analysis, about 12% of the smooth muscle areas examined showed deterioration in the age-matched unirradiated animals. This percentage was increased significantly at doses above 0.1 Gy, ranging between 20 ($P < 0.01$) and 44% ($P < 0.001$), in the irradiated groups. A single dose of only 0.2 Gy ^{20}Ne ions produced significant damage to the smooth muscle cells. Over at least part of the dose range explored, smooth muscle damage increased with dose for all radiation qualities. Although heavy charged particles are more effective in producing damage than photons, the present data are insufficient to demonstrate a LET dependence among charged particles or estimate relative biological effectiveness.

8417 **Sensitization of mouse L cells to ultraviolet light by low amounts of bromodeoxyuridine.** Thomas, G.H.; Maloney, M.A.; Cleaver, J.E. (Univ. of California, San Francisco). *Radiation Research;* **91**: No. 1, 145-154(Jul 1982).

Substitution of bromouracil for at least 5% of the thymines in DNA of mouse L cells causes a maximum sensitization of four- to fivefold to killing by ultraviolet light. The substitution of bromouracil (by incubation of cells with bromodeoxyuridine) results in a net increase in the total number of lesions in DNA per unit dose of radiation, owing to the breaks associated with bromouracil photolysis. Estimates of critical target size from the D_{37} indicate that the additional cytotoxicity caused by bromouracil substitution may be associated with the production of a few breaks in large regions of DNA, suggesting that damage at the level of a chromosome aberration may be the lethal event. Dilution of bromouracil-substituted DNA by growth of cells in thymidine indicated that there was no difference between the sensitivity of cells substituted in one or both strands of DNA. The sensitivity decreased as the number of chromosomes containing bromouracil halved at each cell division and reached normal sensitivity when the number of divisions was sufficient to produce one or fewer substituted chromosomes per cell.

8418 **Abnormal responses to mid-ultraviolet light of cultured fibroblasts from patients with disorders featuring sunlight sensitivity.** Smith, P.J.; Paterson, M.C. (Chalk River Nuclear Laboratories, Ontario, Canada). *Cancer Research;* **41**: 511-518(Feb 1982).

The postultraviolet light (UV) colony-forming ability and DNA repair properties were examined of human skin fibroblasts derived from two groups of donors at high risk of cancer; (a) persons exhibiting sensitivity to sunlight; and (b) persons with conditions possibly associated with an underlying defect in the repair of radiogenic DNA damage. A comparison was made between the effects of far UV (254 nm) and mid UV (313 nm). Biochemical studies performed on strains sensitive to 313-nm UV alone suggest that their unusual photoresponse is not attributable to defective repair of cyclobutyl pyrimidine dimers. Furthermore, our data imply that thymine glycols are unlikely candidates for the critical lethal lesions in 313-nm UV-sensitive strains. Evidence is presented in support of the contention that mid UV may be partially radiomimetic, thus extending our understanding of the deleterious biological effects of this ubiquitous environmental carcinogen. (JMT)

8419 **Newly synthesized hypoxia-mediated drugs as radiosensitizers and cytotoxic agents.** Astor, M. (Columbia Univ., New York, NY); Hall, E.J.; Biaglow, J.E.; Parham, J.C. *International Journal of Radiation Oncology, Biology and Physics;* **8**: No. 1, 75-83(Jan 1982). Contract AC02-78EV04733.

Chinese hamster cells in culture were used to compare the radiosensitizing efficiency and cytotoxicity of misonidazole with several 2, 4 and 5 substituted nitroimidazoles. The two subsituted compounds (SR 2508 and SR 2555) are similar to misonidazole in radiosensitizing effectiveness, but are significantly less toxic to hy-

poxic cells. This reduced cytotoxicity may result from either slower drug penetration or slower removal of non-protein sulfhydryl compounds (NPSH). The compound MJL-1-191-VII* (a 4-nitroimidazole) is a much more effective radiosensitizer than would be predicted from its electron affinity. It appears to sensitize by two mechanisms, the first resulting from its electron affinity and the second a consequence of its rapid removal of endogeneous cellular NPSH; which are naturally occurring radioprotective substances.

8420 **Reevaluations of dosimetric factors: Hiroshima and Nagasaki.** Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982). 309p. (CONF-810928—). NTIS $15.75. Order Number DE81026279.

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

Separate abstracts were prepared for the 13 papers in this proceedings of a symposium on the reevaluation of dosimetric factors for Hiroshima and Nagasaki. A summary and general discussion are included at the end of the proceedings. (KRM)

8421 **Early Atomic Bomb Casualty Commission perceptions and planning.** Friedell, H.L. (Case Western Reserve Univ., Cleveland, OH). pp 1-5 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

A description of the kind of research carried on by the Manhattan Project during World War II is presented. At that time scientists were trying to identify acceptable radiation levels, and to ascertain whether any immediate research was needed to support such levels. The author briefly outlines activities to determine any immediate effects of radiation that occurred after the nuclear strikes in Hiroshima and Nagasaki. (KRM)

8422 **Revised estimates of neutron and gamma-ray doses at Hiroshima and Nagasaki.** Loewe, W.E. (Lawrence Livermore National Lab., CA). pp 25-51 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

In the summer of 1980, Loewe and Mendelsohn of Lawrence Livermore National Laboratory (LLNL) released details of a complete but preliminary new free-field dosimetry at Hiroshima and Nagasaki, which was then finalized in the fall of 1980. This dosimetry was shown to have a major impact on the apparent relationship between leukemia incidence and radiation dose. The steps taken toward developing the LLNL dosimetry are discussed. These are (1) assessment of yields and computed bomb leakage spectra; (2) assumption of atmospheric conditions; (3) application of validation procedure to transport; (4) computation of prompt doses (source neutrons and source and secondary gammas); (5) evaluation and use of delayed (fission-product) gamma dose model; (6) comparison with in situ measurements; evaluation and reinterpretation of neutron activation dosimetry; (7) identification of origins of disagreement with T65 dosimetry; and (8) estimation of uncertainties.

8423 **Findings of a recent Oak Ridge National Laboratory review of dosimetry for the Japanese Atom-bomb survivors.** Kerr, G.D. (Oak Ridge National Lab., TN). pp 52-97 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982). Contract W-7405-ENG-26.

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

A review of the dosimetry for the atom-bomb survivors, requested by the National Council on Radiation Protection through the US Department of Energy, was started in late 1979. Several early studies aimed at resolving the discrepancies gave ambiguous results. This was especially true of sulfur activation by fast neutrons which was more easily related to neutron leakage from the weapons and to neutron exposure of the survivors than thermal neutron activation of other materials. A breakthrough was provided in mid-1980 by information on sulfur activiation found in a Japanese report on radiation surveys made in the two cities immediately after the bombing. Some findings of the review are that the neutron exposures in Hiroshima were probably less than the T65D estimates by factors varying from about 4 at a ground distance of 1000 m to 8 at 2000 m, and the gamma-ray exposures were greater than the T65D estimates starting at about 1000 m and were probably larger by a factor of about 3 at 2000 m. In Nagasaki the situation was reversed with respect to gamma rays, and the T65D estimates were higher, but the differences were small (i.e., about 20% at 1000 m and 30% at 2000 m). As a result, it now appears that leukemia and other late effects at lower exposure levels in Hiroshima were due largely to gamma rays rather than to neutrons. This, however, may not be true at higher exposure levels in Hiroshima. Any reanalysis of data on late effects among the atom-bomb survivors should be regarded as highly speculative until some other important issues have been investigated in more detail.

8424 **Status of Los Alamos efforts related to Hiroshima and Nagasaki dose estimates.** Whalen, P.P. (Los Alamos National Lab., NM). pp 111-130 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

Neutron and gamma-ray leakage spectra measurements will be made at the Los Alamos Critical Assembly Facility (LACAF) on the recently located Hiroshima bomb replicas in a near-critical configuration. These measurements, made with modern techniques, will provide a check for present-day cross sections and calculations. Similar measurements have been proposed on the Mark 9 weapon and on the Ichiban assembly. Two-dimensional calculations of the neutron and gamma-ray outputs of the Hiroshima and Nagasaki weapons are in progress. Calculations of several air-transport experiments are also in progress. Calculated results are compared with experimental results. The neutron and gamma-ray output spectra of several devices tested in the atmosphere at the Nevada Test Site are being calculated. The results of these calculations will allow models of the debris cloud contribution to the total dose to be tested. Calculations have been completed for the Ranger Fox and the Upshot-Knothole Grable tests. Measurements made at the LACAF, in conjunction with calculations, can be used to define the upper limit of the Hiroshima yield.

8425 **Dosimetry studies in Japan.** Maruyama, T. (National Inst. of Radiological Sciences, Chiba-shi, Japan); Kumamoto, Y.; Hashizume, T. pp 201-208 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

In 1967 the National Institute of Radiological Sciences in Chiba estimated the radiation doses in air from the atomic bombing of Hiroshima and Nagasaki by using some building materials exposed to the nuclear explosions in both cities. These estimated doses were in good agreement with the doses estimated on the basis of the Ichiban project by the research group at Oak Ridge National Laboratory which were the basis for the Atomic Bomb Casualty Commission's tentative 1965 radiation dose (T65D). Recently the radiation doses in Hiroshima and Nagasaki have been reevaluated by Lawrence Livermore National Laboratory and Oak Ridge National Laboratory. In Japan a new research group was started last August, with the intention of making new estimates of doses from the atomic bombs in cooperation with US research groups.

8426 **Biological indicators of radiation quality.** Bender, M.A. (Brookhaven National Lab., Upton, NY); Wong, R.M.A. pp 223-240 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982). Contract AC02-76CH00016.

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

The induction of many biological effects by high linear energy transfer (LET) radiation is strikingly different in one or two respects from the induction by acute low-LET radiation. If the acute low-LET dose-effect curve is of the usual quadratic form, it becomes linear as LET increases. In any case the linear slope increases as LET increases; that is, the relative biological effectiveness (RBE) increases. Both changes might be exploited as biological indicators of whether or not the recent recalculations of dose and of neutron contribution to dose at Hiroshima and Nagasaki seem consistent with the epidemiological observations. The biological end points that have been extensively studied in survivors include acute effects, growth and development after in utero or childhood exposure, genetic and cytogenetic effects in offspring, somatic chromosomal aberrations in survivors, and, of course, cancers, including leukemia. No significant indication among offspring of genetic or cytogenetic effects attributable to parental exposure has been found. Among the remaining end points, only the data on somatic chromosomal aberrations and on cancers appear robust enough to allow one to draw definite inferences by comparing experiences at the two cities.

8427 **Sensitivity of Hiroshima and Nagasaki epidemiologic inferences to dosimetric parameters.** Mendelsohn, M.L.; Straume, T.; Dobson, R.L. (Lawrence Livermore National Lab., CA). pp 241-266 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

In this paper the influence that various possible values of physical dosimetric parameters can have on radiobiological interpretations of Hiroshima and Nagasaki epidemiologic data is analyzed. Neutron RBE's (relative biological effectiveness values) calculated from the resulting dose-response relationships are found to be most sensitive to variations in device yield, with a sensitivity ratio (SR) of 1.2 (12% change resulting from 10% parameter change). The RBE's are also very sensitive to neutron output alone (SR = 0.7) of the Hiroshima device. They are least sensitive to gamma-ray output (SR = 0.4) of the Hiroshima device. Gamma-ray risk coefficients, which depend only on Nagasaki data, are inversely proportional to the gamma-ray output (and device yield) of the Nagasaki device. On the basis of the assumption that neutrons could not have been protective, results from this analysis suggest limits on certain physical parameters - device yields and gamma-ray outputs for both cities. No such limits, however, are found for reasonable values of Hiroshima neutron output, and this parameter has the potential for strongly influencing inferences regarding neutron RBE.

8428 **Some confounding factors in the study of mortality and occupational exposures.** Gilbert, E.S. (Pacific Northwest Lab., Richland, WA). *American Journal of Epidemiology;* **116**: No. 1, 177-188(1982). Contract AC06-76RL01830.

With the recent interest in the study of occupational exposures, the impact of certain selective biases in the groups studied is a matter of some concern. In this paper, data from the Hanford nuclear facility population (southeastern Washington State, 1947-1976), which includes many radiation workers, are used to illustrate a method for examining the effect on mortality of such potentially confounding variables as calendar year, length of time since entering the industry, employment status, length of employment, job category, and initial employment year. The analysis, which is based on the Mantel-Haenszel procedure as adapted for a prospective study, differs from most previous studies of occupational variables which have relied primarily on comparing standardized mortality ratios (utilizing an external control) for various subgroups of the population. Results of this analysis confirm other studies in that reduced death rates are observed for early years of follow-up and for those with higher socioeconomic status (as indicated by job category). In addition, workers employed less than two years and especially terminated workers are found to have elevated death rates as compared with the remainder of the study population. It is important that such correlations be taken into account in planning and interpreting analyses of the effects of occupational exposure.

8429 **The modulating effect of retinoids and a tumor promoter on malignant transformation, sister chromatid exchanges, and Na/K ATPase.** Borek, C.; Miller, R.C.; Geard, C.R.; Guernsey, D.; Osmak, R.S.; Rutledge-Freeman, M.; Ong, A.; Mason, H. (Columbia Univ., New York, NY). *Annals of the New York Academy of Sciences;* **359**: 237-250(27 Feb 1981). Contract AC02-78EV04733.

In earlier reports we have shown that a vitamin A analog inhibits radiation-induced transformation in vitro and that retinoids and TPA exert antagonistic effects on vitamin A-binding protein production. Since the tumor promoter TPA has been reported to enhance radiation-induced transformation, it seemed a logical step to follow up these various studies and to investigate whether the antagonism between vitamin A and TPA on cell differentiation in vitro prevails in their effects on radiation-induced transformation in vitro.

8430 **Dependence on stage of growth of mammalian cell sensitivity to near-uv irradiation.** Griego, V.M.; Webb, R.B.; Matsushita, T. (Argonne National Lab., IL (USA)). *Photochemistry and Photobiology;* **33**: No. 2, 211-214(Feb 1981).

The variable sensitivity of exponentially growing mouse myeloma cells (66.2 subclone of MPC11) to monochromatic near-UV (365 nm) radiation was studied by determination of the relative cloning efficiency (i.e. survival) of cells in soft agar. Maximum sensitivity of the cells to near-UV light was found during the middle and late stages of exponential growth when the survival was only one-tenth of that during the early stage of growth. In addition, the shapes of near-UV survival curves changed with the stage of the cells irradiated. These data indicate that stages of growth can substantially alter the response of mammalian cells to near-UV radiation. These data further suggest the importance of testing the response of the cells throughout the growth employed in the experimental procedure.

8431 **Transient conformation changes in chromatin during excision repair of ultraviolet damage to DNA.** Bodell, W.J.; Cleaver, J.E. (Univ. of California, San Francisco). *Nucleic Acids Research;* **9**: No. 1, 203-213(1981). Contract AC03-76SF01012.

DNA labeled for 15 minutes during uv induced repair synthesis is two-fold more sensitive to micrococcal nuclease than the bulk nuclear DNA. As the length of the labeling period increases from 15 minutes to 4 hours the nuclease sensitivity of repair labeled DNA approaches that of bulk chromatin. Pulse-chase experiments indicate that the nuclease sensitivity of the repaired DNA labeled during a brief pulse decreases with a half-life of about 15 minutes. In contrast to previous interpretations, we consider these results to mean that immediately after synthesis, chromatin labeled during repair has a conformation which renders it more susceptible to nuclease digestion than the bulk chromatin. With time these repaired regions are assembled into a nucleosome structure with normal nuclease sensitivity.

8432 **DNA repair in V-79 cells treated with combinations of physical and chemical carcinogens.** Ahmed, F.E.; Setlow, R.B. (Brookhaven National Lab., Upton, NY (USA)). *Photochemistry and Photobiology;* **32**: No. 5, 629-633(Nov 1980).

Excision repair of DNA damage was measured by the photolysis of bromodeoxyuridine incorporated into parental DNA during repair in Chinese hamster V-79 cells treated with 254 nm ultraviolet radiation (UV), 7,12-dimethylbenz[α]anthracene 5,6-oxide (DMBA-epoxide), N-acetoxy-2-acetylaminofluorene(AAAF), 4-nitroquinoline 1-oxide (4NQO), 2-methoxy-6-chloro-9-[3(ethyl-2-chloro-ethyl)-aminopropylamino]acridine dihydrochloride (ICR-170), X-rays, ethylmethanesulfonate (EMS), methyl methanesulfonate (MMS) and combinations of these agents. Compared to normal human cells V-79 were defective in repair of UV lesions and the lesions induced by the UV-mimetic chemicals. V-79 cells repaired X-ray damage and damage from EMS and MMS to the same extent as human cells. Repair was additive after a combination of UV plus MMS indicating, that there are different rate-limiting steps for removal of the damages from these agents. Repair was less than additive in cells treated with UV plus ICR-170, AAAF plus ICR-170,

AAAF plus 4NQO, and 4NQO plus ICR-170 and approximately equal to that observed for the higher of the two agents separately. Although the results on repair after combinations of UV plus 4NQO, UV plus DMBA-epoxide or X-rays plus MMS were difficult to interpret, there was no inhibition of repair in these combinations.

8433 **Mutagenesis of ultraviolet-irradiated lambda phage by host cell irradiation: induction of Weigle mutagenesis is not an all-or-none process.** Hutchinson, F.; Stein, J. (Yale Univ., New Haven, CT). *Molecular and General Genetics;* 177: 207-211(1980). Contract AC02-76EV03571.

Ultraviolet mutagenesis of lambda phage to clear plaque formers is the same in the total phage population and in subpopulations of phage which have also mutated to gam⁻ or at an amber codon. This is true for phage assayed in host cells in which Weigle mutagenesis has been either partially induced by low levels of ultraviolet irradiation, or fully induced by higher levels. If induction of Weigle mutagenesis were all-or-none, clear plaque formers in phage subpopulations selected for another mutation elsewhere would come mainly from induced cells; then the clear plaque mutation rate would always be that for fully induced host cells. Therefore, induction requires more than one lesion in host cell DNA. Although thymine starvation of cells induces synthesis of recA protein, it does not induce Weigle mutagenesis; in fact starvation inhibits the induction of this process on subsequent ultraviolet irradiation of the cells.

5602 Thermal Effects

8434 **Conformation of the deoxydinucleoside monophosphate dCpdG modified at carbon 8 of guanine with 2-(acetylamino)fluorene.** Hingerty, B.; Broyde, S. (Oak Ridge National Lab., TN). *Biochemistry;* 21: 3243-3252(1982). Contract W-7405-ENG-26.

Minimized conformational potential energy calculations were performed for dCpdG modified with the carcinogen 2-(acetylamino)fluorene (AAF). The major adduct, linked via a covalent bond between guanine C-8 and N-2 of AAF, was investigated. The 12 variable torsion angles and both dexoyribose puckers were independent flexible parameters in the energy minimizations. Three categories of low-energy conformers were calculated in which the guanine was syn and nearly perpendicular to the plane of the fluorene: (1) forms in which fluorene is stacked with cytidine (included among these is the global minimum energy conformation); (2) conformers which preserve guanine-cytidine stacking while placing the fluorene in a base-pair obstructing position; (3) conformers which maintain guanine-cytidine stacking and place the fluorene at the helix exterior, without interfering with base pairing. The Z form is important in this group. In addition, a low-energy conformation with guanine anti, but still nearly perpendicular to fluorene, was computed. Molecular models were constructed for the most important conformations incorporated into larger polymers. These indicated that the fluorene-cytidine stacked forms induce a severe kink in the B helix. Conformers with guanine-cytidine stacking and AAF in a base-pair obstructing position place the AAF at the B-type helix interior with little distortion in the helix direction. Conformers with the guanine-cytidine stack in which AAF does not affect base pairing place the fluorene at the Z or alternate helix exterior. It is suggested that base sequence, extent of modification, and external conditions such as salt concentration determine which of a number of possible conformational effects is actually induced by AAF. The variety of observed experimental results with AAF-modified DNA may reflect these various conformational possibilities.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 6926, 6974, 8277, 8299, 8312, 8389, 8396, 8429

8435 **(ORNL—5869) Development of predictive models for xenobiotic bioaccumulation in terrestrial ecosystems.** Trabalka, J.R.; Garten, C.T. Jr. (Oak Ridge National Lab., TN (USA)). Oct 1982. Contract W-7405-ENG-26. 259p. NTIS, PC A12/MF A01. Order Number DE83003171.

We evaluated the suitability of existing, simple empirical models developed for aquatic organisms and the question of extending such models to terrestrial systems. Data sets of other investigators were expanded, and edited showing r^2 values associated with regressions fell significantly. Expansion of the analysis to include nonruminant mammals and birds produced similar conclusions. A simple sorting model based on hydrophobic tendency was able to successfully separate all but one bioaccumulation hazards from groups of organic compounds ($N > 100$) when the screening criterion was a specified bioconcentration factor for fish/water (in water-only exposure systems or model ecosystems) or mammal-bird/diet (long-term feeding under laboratory conditions). Approximately one-fourth of the chemicals sorted into the hazardous category did not exhibit significant bioaccumulation and the one hazardous material, which would not have been identified as such, was methylmercury. Results indicate that, although a measure of hydrophobicity is a highly satisfactory first approximation indicator for bioaccumulation potential for most organics in both terrestrial and aquatic vertebrates, this potential is frequently controlled by environmental factors and specific metabolic/steric interactions not adequately represented in existing SARs.

8436 **(PB—82-213133) Mining hazard evaluation and technical assistance report no. HHE-80-108-111, Agricultural Stabilization and Conservation Service, Kingwood, West Virginia.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1980. 7p. NTIS, PC A02/MF A01.

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) on February 26, 1980, at the Agricultural Stabilization and Conservation Service (ASCS) office, Kingwood, WV. This survey was conducted to investigate complaints of eye and nasal irritation, as well as general discomfort from exposure to solvent vapors invading the ASCS office area. ASCS office personnel were exposed to perchloroethylene (PCE) vapors generated in the Patriot Coal Co. Float-and-Sink Testing laboratory which is located in an adjacent room of the same building. Although the laboratory was not performing float-and-sink tests at the time the survey was conducted, PCE vapor concentrations in the ASCS office were measured at 20 parts per million (ppm). A comprehensive industrial hygiene survey was conducted at the Patriot Coal Co. laboratory. Recommendations to control the PCE vapors have been made to the company through a formal report. The control measures recommended should eliminate the ASCS office personnel's exposure to PCE.

8437 **Adaptive resynthesis of O^6-methylguanine-accepting protein can explain the differences between mammalian cells proficient and deficient in methyl excision repair.** Waldstein, E.A.; Cao, E.H.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Proceedings of the National Academy of Sciences of the United States of America;* 79: No. 17, 5117-5121(Sep 1982).

Mammalian cells have been classified as proficient (Mer^+) or deficient (Mer^-) in methyl excision repair in terms of their cytotoxic reactions to agents that form O^6-alkylguanine and their abilities to reactivate alkylated adenoviruses. O^6-Methylguanine (O^6MeGua) is considered to be a lethal, mutagenic, and carciogenic lesion. We measured the abilities of cell extracts to transfer the methyl group from an exogenous DNA containing O^6MeGua to acceptor protein. The constitutive level of acceptor activity was independent of the Mer phenotype and was $\approx$ 100,000 acceptor sites per cell. Treatment of cells with N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) results in a dose-dependent decrease in the acceptor activity in extracts because the rapid reaction between endogenous O^6MeGua and acceptor protein makes the latter unavailable for further reaction. Treatment of cells with multiple low doses of MNNG results in the enhanced production of O^6MeGua-accepting protein in levels 2.5-fold above the constitutive values for Mer^+ tumor cells and to $\approx$ 1.5-fold for Mer^+ fibroblasts or Mer^- simian virus 40-transformed cells. Such treatments reduce the activities in Mer^- tumor cells and Chinese hamster cells. We concluded; (i) estimates of O^6MeGua in cellular DNA shortly after treatment may be seriously in error because of the rapid repair of this lesion, and (ii) the adaptive resynthesis of acceptor protein, not its constitutive

level, is the important correlate of cell resistance to methylating agents.

8438 Treatment of cooling systems containing high levels of Legionella pneumophila. Fliermans, C.B.; Bettinger, G.E.; Fynsk, A.W. (DuPont, Aiken, SC, USA). *Water Research;* **16**: No. 6, 903-909(1982).

Elevated levels of L. pneumophila were observed in well-maintained cooling towers and air conditioning systems. Several of these systems were treated by continuous or shock chlorination procedures while density estimates and electron transport activity measurements for L. pneumophila were made. The resulting data demonstrate that L. pneumophila can be controlled at acceptable levels in these systems. 16 refs.

8439 Acute cytotoxicity of fossil-energy-related comparative research materials. Schultz, T.W. (Oak Ridge National Lab., TN). *Journal of Environmental Science and Health, Part A: Environmental Science and Engineering;* **A17**: No. 2, 153-167(1982). Contract W-7405-ENG-26.

Aqueous extracts of five fossil-energy-related comparative research materials have been examined under acute static conditions for toxic effects by use of the Tetrahymena assay system. Cells were exposed to various concentrations of extracts, and cytolysis and population growth impairment were monitored. In addition, chemical class fractionation and major organic elemental analysis were performed. Synthetic fossil fuel materials are more toxic than conventional petroleum crude oils and coal-derived materials are more toxic than crude shale oil. Synthetic fossil-fuel-related materials have a higher nitrogen and oxygen content and a greater aromaticity than do natural crude oils. Acute toxicity appears to be correlated with ether-soluble acid (phenolic) content, mono- and diaromatic hydrocarbon content, and ether-soluble base (primary aromatic amines and azaarenes) content.

8440 Epidemiologic study of neural tube defects in Los Angeles County. II. Etiologic factors in an area with low prevalence at birth. Sever, L.E. (Pacific Northwest Lab., Richland, WA). *Teratology;* **25**: 323-334(1982). Contract AC06-76RL01830.

Epidemiologic characteristics of neural tube defect (NTD) births occurring in Los Angeles County, California, residents during the period 1966-1972 are presented. The prevalence at birth was 0.52/1000 births for anencephalus, 0.51/1000 for spina bifida, and 0.08/1000 for encephalocele, rates considered to be low for a predominantly white population. We hypothesized that environmental (nongenetic) factors are of less etiologic importance in a low-prevalence population than in areas or time periods with high prevalence. We tested that hypothesis by examining epidemiologic characteristics of NTDs in Los Angeles County and comparing them with high-prevalence populations. The data did not support a major etiologic role for environmental factors: (1) no significant differences between rates by month of birth or conception; (2) no significant association with maternal age or parity for anencephalus; for spina bifida a significant maternal age effect ($P < 0.01$) and for encephalocele a parity effect ($P < 0.02$); and (3) no significant relationship with father's occupational class for either anencephalus or encephalocele but a marginally significant ($P < 0.05$) inverse association for spina bifida when a statistic based on ordinal relationships was used. Findings supporting the importance of genetic factors in etiology included: (1) a high percentage of males; (2) a higher twin concordance rate than in high-prevalence populations; and (3) an anencephalus rate among blacks comparable with rates for blacks in other United States populations. Our findings in conjunction with those from other areas and times of low prevalence suggest environmental factors play a relatively insignificant role in the etiology of NTDs in such populations.

8441 CHO-cell strain having hypersensitivity to mutagens, a defect in DNA strand-break repair, and an extraordinary baseline frequency of sister-chromatid exchange. Thompson, L.H.; Brookman, K.W.; Dillehay, L.E.; Carrano, A.V.; Mazrimas, J.A.; Mooney, C.L.; Minkler, J.L. (Lawrence Livermore National Lab., CA). *Mutation Research;* **95**: 427-440(1982). Contract W-7405-ENG-48.

A mutant of CHO cells (strain EM9) previously isolated on the basis of hypersensitivity to killing by ethyl methanesulfonate (EMS) is approx. 10-fold more sensitive than the parental line, AA8, to killing by both EMS and MMS. It is also hypersensitive to killing by other alkylating agents (ethyl nitrosourea and N-methyl-N'nitro-N-nitrosoguanidine), x-rays, and ultraviolet radiation. The production and repair of DNA single-strand breaks (SSB) were studied using the technique of alkaline elution of DNA from filters. After exposure to 4 Gy of x-rays at 0°C and subsequent incubation at 25°C, SSB were repaired within 12 min in AA8, but little repair occurred in EM9. Similarly, with doses of EMS or MMS that produced comparable numbers of SSB in AA8 and EM9 at the end of a 10-min exposure, repair of SSB occurred more rapidly in AA8 than in EM9, suggesting that individual SSB are longer lived in EM9. EM9 was found to be hypersensitive also to the induction of mutations and sister-chromatid exchanges (SCE) by EMS; per unit dose the mutant had twice as many mutations to thioguanine resistance, 3 times as many mutations to azaadenine resistance, and a 7-fold enhancement in SCE, compared to AA8. Moreover, the baseline frequency of SCE in the mutant was extraordinarily high, i.e., 8.6 +- 0.6 vs. 107 +- 5 SCE/cell for AA8 and EM9, respectively, with 10 μM BrdUrd in the medium. The high SCE frequency in EM9 did not vary significantly with BrdUrd concentration over the range examined from 2.5 to 20 μM, and the percentage of 5-bromouracil substitution in the DNA was the same in EM9 and AA8 under these conditions. Thus, EM9 may carry a pleiotropic mutation affecting some function in DNA replication and/or DNA repair and causing the variety of phenotypic properties described in this study.

8442 Bioaccumulation kinetics and organ distribution of nickel in the marine clam (Protothaca staminea). Hardy, J.T.; Roesijadi, G. (Battelle Pacific Northwest Labs., Sequim, WA). *Bulletin of Environmental Contamination and Toxicology;* **28**: 566-572(1982). Contract AC06-76RL01830.

Man's activities, primarily fossil fuel combustion, currently introduce about 47 x 10^6 kg of Ni per year into the world's atmosphere; this rate is expected to increase greatly during the next 20 years. Much of this Ni is associated with sub-micron atmospheric particles. When these particles deposit at the sea surface, about 47% of the associated Ni is released in a soluble form that could enter marine food webs. Ni is normally present in seawater at 0.1 to 2.4 μg/L and Ni concentrations in marine pelycepods range from 0.05 to 3.2 μg/g dry wt, depending upon the location of collection. Higher concentrations of Ni in seawater may be toxic to marine life. The 48-h LC_{50} for Ni is 1180 and 310 μg/L for oyster embryos and hard-shell clam embryos, respectively. Little information exists regarding the ability of marine shellfish to concentrate Ni from seawater. Our studies were undertaken to determine the degree of bioconcentration, kinetics of accumulation, and tissue distribution of Ni in marine clams exposed to seawater enriched with subtoxic levels of Ni.

8443 Epidemiologic approaches to reproductive hazards of the workplace. Sever, L.E. *Birth Defects, Original Article Series;* **18**: No. 3A, 33-38(1982). Contract AC06-76RL01830.

In discussing studies of environmental factors in the causation of birth defects, R.W. Smithells stated at the Fifth International Conference on Birth Defects, it is time we paid a little more attention to the occupational hazards of parents of both sexes. Clearly, on the basis of current interest and activity, the time has come - and the time is now. Important issues contributing to the recent dramatic increase in discussions of potential reproductive hazards of the workplace include legal and sociopolitical factors, increasing knowledge about environmental health hazards, and an appreciation of the susceptibility of the fetus to noxious agents. When coupled with the recognition of carcinogens in the workplace, relationships noted between carcinogenicity and teratogenicity, and an increase in teratologic testing, the stage is set for a flurry of regulatory and research activities regarding occupational reproductive hazards. Much of the current concern grows not out of studies showing major risks but, rather from a lack of knowledge; necessary are epidemiologic studies of worker populations. Although many arguments can be, and have been, made about the relative importance of teratologic and epidemiologic studies, it is clear that animal teratology cannot provide definitive answers to problems of human reproductive health. Thus, both teratologic and epidemiologic data must be obtained and evaluated. We discuss here epidemiologic ap-

proaches to studying effects of embryonic-fetal exposure. We consider study designs used, some of the pregnancy outcomes of concern, determining exposures, and regulatory activities.

8444 **Epidemiologic study of neural tube defects in Los Angeles County. I. Prevalence at birth based on multiple sources of case ascertainment.** Sever, L.E. (Pacific Northwest Lab., Richland, WA); Sanders, M.; Monsen, R. *Teratology;* **25**: 315-321(1982). Contract AC06-76RL01830.

Epidemiologic studies of the neural tube defects (NTDs), anencephalus and spina bifida, have for the most part been based on single sources of case ascertainment in past studies. The present investigation attempts total ascertainment of NTD cases in the newborn population of Los Angeles County residents for the period 1966 to 1972. Design of the study, sources of data, and estimates of prevalence rates based on single and multiple sources of case ascertainment are here discussed. Anencephalus cases totaled 448, spina bifida 442, and encephalocele 72, giving prevalence rates of 0.52, 0.51, and 0.08 per 1000 total births, respectively, for these neural tube defects - rates considered to be low. The Los Angeles County prevalence rates are compared with those of other recent North American studies and support is provided for earlier suggestions of low rates on the West Coast.

8445 **Effects of benzene inhalation on murine pluripotent stem cells.** Cronkite, E.P.; Inoue, T.; Carsten, A.L.; Miller, M.E.; Bullis, J.E.; Drew, R.T. (Brookhaven National Lab., Upton, NY). *Journal of Toxicology and Environmental Health;* **9**: 411-421(1982). Contract AC02-76CH00016.

Effects of benzene inhalation on mouse pluripotent hematopoietic stem cells have been evaluated. Male mice 8 to 12 wk old were exposed to 400 ppM benzene for 6 h/d, 5 d/wk, for up to 9 1/2 wk. At various time intervals exposed and control animals were killed, and cardiac blood was evaluated for changes in white blood cell (WBC) and red blood cell (RBC) content. In addition, femora and tibiae were evaluated for total marrow cellularity, stem cell content (as measured by the spleen colony technique), and the percent of stem cells in DNA synthesis (as determined by the tritiated thymidine cytocide technique). Exogenous spleen colonies grown from marrow of exposed animals were counted, identified, and scored by histological type. Exposure to benzene caused significant depressions of RBCs and WBCs throughout the exposure period, which continued for at least 14 d after exposure. Bone marrow cellularity and stem cell content were also depressed in exposed animals throughout the study. Tritiated thymidine cytocide of spleen colon-forming cells was generally increased in exposed animals, perhaps indicating a compensatory response to the reduction of circulating cells. Spleen colonies of all types were depressed after exposure to benzene. The significance of the reduction in cellularity, stem cell content, and changes in morphology of spleen colonies is discussed in relation to cellular toxicity and residual injury.

8446 **Distribution and effects of intravenous lead in the fetoplacental unit of the rat.** Hackett, P.L.; Hess, J.O.; Sikov, M.R. (Pacific Northwest Lab., Richland, WA). *Journal of Toxicology and Environmental Health;* **9**: 1021-1032(1982). Contract AC06-76RL01830.

Lead metabolism was studied in the fetoplacental unit (FPU) of Wistar rats during the genesis of developmental abnormalities and embryonic death. Female rats were injected iv with tracer $^{210}Pb(NO_3)_2$, alone or in combination with 5 or 25 mg $Pb(NO_3)_2$/kg, at 9 or 15 days of gestation (dg). The distribution of lead and its effects were determined in the FPUs during the ensuing 30-h period and at 20 dg. Hemorrhage of the egg cylinder was noted as early as 6 h postinjection of 25 mg/kg at 9 dg. By 20 dg, fetuses exhibited characteristic stunting and external malformations (gastrochisis and severe skeletal defects). Administration of this dose at 15 dg produced petechial hemorrhage in fetal brain within 90 min; more massive hemorrhage was a consistent observation by 24 h. At 20 dg, embryo mortality was 44% in rats injected with 25 mg/kg at 9 dg and 100% in those injected at 15 dg. At 90 min after injection, lead content of 15-dg FPUs was 10 times that of the 9-dg FPUs, but the weights of the 15-dg FPUs were 16 times greater. Values remained relatively constant in 15-dg FPUs for 30 h, but early clearance was observed after injection at 9 dg, with a return to 90-min values by 20 dg. In the 15-dg FPUs, placental clearance was followed by fetal lead incorporation, which reached a maximum at 6 h. Fetal lead values were constant from 6 to 30 h after injection at tracer and 5-mg/kg dose levels, but values increased progressively at 25 mg/kg. Both temporal and quantitative relationships of fetal lead metabolism were disrupted by the 25-mg/kg dose, but the nature of the effect was determined by the stage of fetal development at exposure.

8447 **Effect of dose level and pregnancy on the distribution and toxicity of intravenous lead in rats.** Hackett, P.L.; Hess, J.O.; Sikov, M.R. (Pacific Northwest Lab., Richland, WA). *Journal of Toxicology and Environmental Health;* **9**: 1007-1020(1982). Contract AC06-76RL01830.

Female Wistar rats were injected intravenously with tracer levels of ^{210}Pb, alone or combined with carrier $Pb(NO_3)_2$ at 5 or 25 mg/kg body weight at 9 or 15 days of gestation (dg). Tissue ^{210}Pb distribution and retention, and lead excretion, were measured several times during the first 30 h and at 20 dg. Toxic effects following the administration of 25 mg/kg (a teratogenic dose) included an early decrease in hematocrit, hematuria, gastrointestinal hemorrhage, and diarrhea, as well as an eventual loss of body weight and an increase in spleen and kidney weights. The stage of pregnancy at injection did not affect the retention and distribution of lead in major organs other than the reproductive system. Following injection of the 25-mg/kg dose, deposition of lead in the liver, kidney, spleen, and lung was elevated. Disproportionately high plasma lead levels were also observed at early times after the injection of the 25-mg/kg dose, and may act as a significant factor in placental lead transfer and subsequent malformations or fetal mortality.

8448 **Numerical variation of dark cells in normal and chemically induced hyperplastic epidermis with age of animal and efficiency of tumor promoter.** Klein-Szanto, A.J.P.; Slaga, T.J. (Oak Ridge National Lab., TN). *Cancer Research;* **41**: 4437-4440(Nov 1981). Contract W-7405-ENG-26.

The percentage of dark basal keratinocytes was quantitatively assessed in normal epidermis of Sencar mice before and after birth and in adult epidermis after topical application of several compounds of varying promoting efficiency. The percentage of dark keratinocytes reached a maximum at the 19th day of gestation (~40%) and fell abruptly after birth (~3%). Old animals exhibited a very low number of dark basal cells (0.2%). After topical application of the weak promoters resiniferotoxin, anthralin, ethylphenylpropiolate, and 12-deoxyphorbol-13-2,4,6-decatrienoate, the percentage of dark cells in young adult epidermis did not differ markedly from that in control (acetone-treated) specimens. The strong first-stage promoters 4-O-methyl-12-O-tetradecanoylphorbol-13-acetate and calcium ionophore A 23187, as well as the strong complete promoter 12-deoxyphorbol-13-deoxyphorbol-13-decanoate, induced the appearance of large numbers of dark keratinocytes, in a percentage similar to that seen after 12-O-tetra-decanoylphorbol-13-acetate application (~20%). The similarities between the dark keratinocytes seen after topical application of 12-O-tetradecanoylphorbol-13-acetate or other strong promoters and the dark cells observed in the fetal epidermis before the onset of the adult type of epidermal keratinization indicate that potent and/or first stage tumor promoters can be identified by their ability to induce cells resembling fetal-type dedifferentiated keratinocytes.

8449 **Phospholipid derivatives of nucleoside analogs as prodrugs with enhanced catabolic stability.** Matsushita, T. (Argonne National Lab., IL); Ryu, E.K.; Hong, C.I.; MacCoss, M. *Cancer Research;* **41**: 2707-2713(Jul 1981). Contract W-31-109-ENG-38.

The nucleoside 5'-diphosphate-L-1,2-dipalmitin derivatives of 1-β-D-arabinofuranosylcytosine (ara-D), 9-β-D-arabinofuranosyladenine (ara-A), and tubercidin have been synthesized, and their cytotoxicity has been evaluated against a mouse myeloma cell line (MPC-11) in vitro and against L1210 lymphoid leukemia both in vitro and in vivo. Sonication methods were utilized to solubilize these lipophilic derivatives in aqueous solution in order to facilitate such biological evaluation; the ara-A derivative resisted solubilization by several techniques. (JMT)

8450 **Distribution and ultrastructural characteristics of dark cells in squamous metaplasias of the respiratory tract epithelium.** Klein-Szanto, A.J.P.; Nettesheim, P.; Pine, A.; Martin, D. (Oak Ridge National Lab., TN). *American Journal of Pathology;* 103: No. 2, 263-270(May 1981). Contract W-7405-ENG-26.

Dark epithelial basal cells were found in both carcinogen-induced and non-carcinogen-induced squamous metaplasias of the tracheal epithelium. Formaldehyde-induced squamous metaplasias exhibited 4% dark cells in the basal layer. Metaplasias induced by vitamin A deficiency and those induced by dimethylbenz(a)anthracene (DMBA) without atypia showed 18-20% basal dark cells. DMBA-induced metaplasias with moderate to severe atypia exhibited 50% basal dark cells. The labeling index of basal cells in metaplastic epithelia, regardless of the inducing agent, was 16-18%, ie, the same as that of the normal esophageal stratified squamous epithelium. The percentage of labeled dark basal cells per total dark cell population was approximately 19% in the non-carcinogen-induced metaplasias and in the DMBA-induced metaplasias without atypia. In the atypical metaplasias induced by DMA this percentage increased to 26. On the basis of ultrastructural observations, five types of dark epithelial cells could be distinguished in the metaplastic epithelia. Each type of squamous metaplasia could thus be recognized by a determined numerical distribution of dark cells in the basal layer and a specific pattern of distribution of the ultrastructurally defined dark cell categories.

8451 **Mammalian in vivo and in vitro cytogenetic assays: A report of the U.S. EPA's Gene-Tox Program.** Preston, R.J. (Oak Ridge National Lab., TN); Au, W.; Bender, M.A.; Brewen, J.G.; Carrano, A.V.; Heddle, J.A.; McFee, A.F.; Wolff, S.; Wassom, J.S. *Mutation Research;* 87: 143-188(1981). Contract W-7405-ENG-48.

This report presents an assessment made by the U.S. Environmental Protection Agency Gene-Tox Program's Work Group on mammalian cytogenetics of the clastogenic effects of chemicals in in vivo and in vitro mammalian cell assays. Six assays were reviewed: bone marrow (32 papers, 31 chemicals), spermatogonial (10 papers, 10 chemicals), spermatocyte (25 papers, 25 chemicals), oocyte or early embryo (18 papers, 19 chemicals), in vitro cell culture (30 papers, 66 chemicals), and comparisons were then made between them for their similarities or differences in producing a positive or negative clastogenic effect of a particular chemical or chemical class. A large proportion of the available cytogenetic data was not suitable for inclusion in the final data base because of poor experimental design or unsatisfactory reporting of the information. It was not possible to recommend any one assay for determining potential clastogenicity because each had its own particular advantages and limitations and provided unique information.

8452 **Permeability of the 17-day fetal rat pancreas to glycerol and dimethylsulfoxide.** Mazur, P.; Rajotte, R.V. (Oak Ridge National Lab., TN). *Cryobiology;* 18: 1-16(1981). Contract W-7405-ENG-26.

The purpose of the present study was to determine the kinetics of permeation of two additives (glycerol and Me_2SO) at two temperatures (0 and 22°C) in the 17-day fetal rat pancreas. These two additives were chosen partly because they are the most commonly used in cryobiology and partly because they differ in the rate with which they permeate cells; Me_2SO generally permeates considerably more rapidly than does glycerol and, therefore, ought to present fewer osmotic problems. Two temperatures were chosen to permit an estimate of the temperature coefficient of the permeation.

8453 **Diminution of mouse epidermal superoxide dismutase and catalase activities by tumor promotors.** Solanki, V. (Oak Ridge National Lab., TN); Rana, R.S.; Slaga, T.J. *Carcinogenesis (New York);* 2: No. 11, 1141-1146(1981). Contract W-7405-ENG-26.

The effects of phorbol ester tumor promoters and related compounds on superoxide dismutase (SOD) and catalase were examined. The treatment of adult mouse skin with 2 μg 12-0-tetradecanoylphorbol-13-acetate (TPA) resulted in a sustained decrease in the basal levels of both SOD and catalase activities in the epidermis. A decline in SOD activity occurred within 2 h after application and the maximum effect was seen at 16-17 h. The decrease in SOD activity was always accompanied by a similar decline in the epidermal catalase activity. The alterations in both enzymes occurred against a high background of enhanced protein synthesis which indicates that the effect of TPA is selective for SOD and catalase. Other tumor promoters such as phorbol 12,13-dibutyrate and the non-phorbol tumor promoter anthraline also lowered the activities of both the enzymes. Mezerein, a resiniferonol derivative with weak promoting activity but a potent stage-II promoter, appeared to be more potent than TPA in lowering the basal levels. These results indicate that damage which favors neoplastic progression would occur in TPA-treated mouse skin due to the accumulation of free radicals resulting from low levels of SOD and catalase activity. In addition, the TPA-caused decrease in the levels of SOD and catalase was not prevented by either retinoic acid, fluocinolone acetonide, tosyl amino-2-phenylethyl chloromethyl ketone, or butylated hydroxytoluene, suggesting that inhibition of tumor promotion by these agents is not mediated through alterations in the levels of enzymatic activities which decrease free radical concentrations.

8454 **Quantifying general population response to environmental lead.** Brown, C.D. (Argonne National Lab., IL). pp 14-15 of Environmetrics 81: summaries of conference presentations. Philadelphia, PA; SIAM Publications (1981). Contract W-31-109-ENG-38.

From Environmetrics 81; Alexandria, VA, USA (8 Apr 1981).

The following discussion describes an approach for quantifying health response to low level environmental lead. The technique incorporates an assumption of lognormality for lead body burdens in an exposed population. It also utilizes a biochemical response specific to lead, inhibition of ferrochelatase, for estimating individual health risk.

8455 **Characterization of mercury-binding proteins from the gills of marine mussels exposed to mercury.** Roesijadi, G.; Hall, R.E. (Battelle Pacific Northwest Lab., Sequim, WA). *Comparative Biochemistry and Physiology;* 70C: 59-64(1981). Contract AC06-76RL01830.

A low molecular weight, mercury-binding protein was isolated from the gills of Mytilus edulis and partially characterized. This protein had a minimum mol. wt of 14,400 daltons and 115 amino acid residues per protein molecule. The relatively low amounts of half-cystine (7.8 mol %) in this protein and the presence of aromatic amino acids and histidine were not characteristic of metallothionein. The amino acid acid composition was similar to a cadmium-binding protein of mussels reported by other researchers.

8456 **Exposure of the consumer to cadmium - a critical review.** Diehl, J.F. Karlsruhe, Germany; Bundesforschungsanstalt fuer Ernaehrung (1981). 85p. (In German). (BFE—1981/3). Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Remlingen (Germany, F.R.). Inst. fuer Tieflagerung.

According to media reports the cadmium level in foods has been steadily increasing in recent years. It has further been claimed that contamination of foods by cadmium has already caused 10 000 to 100 000 cases of kidney disease in the Federal Republic of Germany. A critical evaluation of recent research in this field leads to the conclusion that these claims are not based on fact. Average cadmium levels in foods in the Federal Republic are approximately in the same range as in many other countries and there is no indication of generally increasing cadmium levels in the diet or in particular foodstuffs.

8457 **(ORNL-tr—4910) Toxic action of uranium compounds upon dermal application utilizing the neutron-activation method.** Arifov, U.A.; Berent, N.E. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. Translated from Akademiia Nauk Uzbekskoi SSR, Tashkent Smst. Yadernoi fiziki neitronno-aktivatsionnyi analiz, 1971. 8p. NTIS, PC A02/MF A01. Order Number DE83001766.

The effects of various doses of soluble and insoluble uranium compounds applied to the skin of mice, rats, and rabbits was studied. The urine of the treated animals was collected and the concen-

tration of protein determined as functions of the dose of uranium given and the time elapsed since application. Mortality and clinical signs of poisoning are discussed. (ACR)

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 7879, 8387

8458 **(GSF-AO—280) Investigation of interaction mechanisms between biological samples and an extremely narrow-band dye laser.** Schoerner, J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Angewandte Optik; Technische Univ. Muenchen (Germany, F.R.). Fachbereich Elektrotechnik). Aug 1980. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750700.

Thesis.

Two problems connected with the investigation of the interaction between laser light and biological samples, using an extremely narrow-band dye laser, have been investigated: 1. Influence of classic absorption on the threshold value of damage in the microperforation of organic samples. Using a dyed biological standard, threshold values of damage have been carried out in dependence of wavelength, and the findings have been interpreted on the basis of model calculations. 2. Influence of energy conduction during laser irradiation on the threshold value of damage. This problem is investigated by varying the irradiated spot in the fundus of the rabbit eye. Losses in heat conductivity during laser irradiation are determined by model calculations. Both problems are investigated using a specially developed, extremely narrow-band dye laser. The structure of the laser is described along with a special arrangement to narrow down the laser emission wavelength.

8459 **NMR imaging produces no observable mutations or cytotoxicity in mammalian cells.** Schwartz, J.L.; Crooks, L.E. (Univ. of California, San Francisco). *AJR, American Journal of Roentgenology;* **139**: No. 3, vp(Sep 1982).

Chinese hamster ovary cells in culture were exposed to the radiofrequency fields and the static and changing magnetic fields associated with nuclear magnetic resonce imaging. After a 24 hr exposure, no cytotoxicity was observed and the frequency of 6-thioguanine-resistant mutants was unaffected. Thus, at exposures that greatly exceed those that might be used in a clinical situation, NMR imaging caused no detectable genetic (mutational) damage and did not affect cell viability.

57 HEALTH AND SAFETY

8460 **(NP—3900501) One-hundredth coal report of Illinois.** (Illinois Dept. of Mines and Minerals, Springfield (USA)). 1981. 403p. NTIS, PC A18/MF A01. Order Number DE83900501.

The 1981 annual report of the Illinois Department of Mines and Minerals tabulates data on levels of coal production, labor and employment in coal industry, and mechanization in the industry. The report reflects an unprecedented safety record achieved during 1981 with no mine-related fatalities reported.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 6951, 7003, 7048, 8473

8461 **(GSF-R—267) Studies on the discharge from Vernagtferner with special regard to meltwater within the firn aquifer runoff.** Oerter, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie). Aug 1981. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750737.

The report describes the runoff from a glacier with the runoff from Vernagtferner glacier as an example. Especially the storage and drainage processes in the firn body and the contribution of the snow meltwater to the total runoff are described using dye tracers and the environmental natural isotopes D, T and O-18.

8462 **(NUREG/CR—2862) Geomorphic processes and evolution of Buttermilk Valley and selected tributaries, West Valley, New York. Phase II. Fluvial systems and erosion study.** Boothroyd, J.C.; Timson, B.S.; Dunne, L.A. (Earth Surface Research, Inc., Narragansett, RI (USA); Earth Surface Research, Inc., Augusta, ME (USA); New York State Geological Survey, Albany (USA)). Jul 1982. 254p. NTIS, PC A12/MF A01 - GPO. Order Number DE83900125.

Repetitive bar and channel mapping at several scales, clast size and movement measurements, suspended-sediment sampling, and stream gaging of a 5 km reach of Buttermilk Creek and selected tributaries at West Valley, New York, have been carried out to determine short-term depositional and erosional processes as well as long-term valley changes adjacent to the low-level nuclear waste disposal site and other areas of the Western New York Nuclear Service Center. Changes to bar-and-channel geometry in Buttermilk Creed are the result of migration of large transverse bars in equilibrium with large floods, such as occurred during Hurricane Fredric, September 1979. Large amounts of lower terrace gravel are also recycled during these events. Downslope movement of landslides by slumping and earthflow appears to be a continuous process (1.5 m^3yr^{-1}). Volumetrically it is a small sediment source except when sudden failure by block gliding deposits a large mass in Buttermilk Creek. Quantitative values of bedload transport, suspended-load sediment transport, and reservoir infill rates compare well with a simple denudation rate (6600 m^3yr^{-1}). The middle-to high-level fluvial terraces in Buttermilk Creek are either adjacent to tributary confluences and preserved by an excess of bedload over transport capacity, or survive because the channel is stable on the opposite side of the valley for unknown reasons. The convex longitudinal profile of Franks Creek/Erdman Brook suggests that it is unstable and will continue to downcut rapidly. Valley widening will occur by parallel retreat of slopes. The future lowering of Buttermilk Creek is controlled by bedrock floors in Cattaraugus Creek and lower Buttermilk Creek. However, tributary lowering and widening will continue independent of a change in base-level of Buttermilk Creek.

8463 **(NUREG/CR—2908) Faulting in southwest Indiana.** Ault, C.H.; Sullivan, D.M. (Indiana Geological Survey, Bloomington (USA)). Oct 1982. 59p. NTIS, PC A04/MF A01 - GPO $4.75. Order Number DE83900411.

Portions of document are illegible.

Faults of the Wabash Valley Fault System, faults in Perry and Spencer Counties, Indiana, and the Mt. Carmel Fault are of the normal type and high angle and occur as single fault planes or as well-defined compound faults as much as 50 miles long with displacements ranging from a few feet to more than 400 feet. The Wabash faults and those in Perry and Spencer Counties were formally mapped, described, and named for the first time. Although supporting deep-drilling data are sparse, the Wabash and Mt. Carmel faults are probably present at depth, where they may form major structural alignments in basement rocks. No past studies have associated earthquake centers with any of the faults. The Wabash and Perry and Spencer County faults are post-Pennsylvanian and pre-Pleistocene in age. Early movement on the Mt. Carmel Fault is post-Valmeyeran, possibly Chesterian in age. The Wabash faulting is probably related to the regional tectonics that produced the New Madrid disturbance, but it is not a direct continuation of New Madrid faulting across the Rough Creek Fault Zone. The Mt. Carmel Fault may be associated with the hinge line of the eastern shelf of the Illinois Basin.

8464 **Upstream finite element method for solution of transient transport equation in fractured porous media.** Noorishad, J.; Mehran, M. (Lawrence Berkeley Lab, CA, USA). *Water Resources Research;* **18**: No. 3, 588-596(Jun 1982).

A finite element method for the solution of two-dimensional transient dispersive-convective transport of nonconservative solute species in fractured porous media is presented. A two-nodal point one-dimensional transport element for fractures is developed which provides a number of advantages relative to conventional fracture

representation by two-dimensional continuum elements. To eliminate the oscillatory behavior of convective-dominated transport which is a more likely occurrence in fracture, an efficient one-dimensional upstreaming method along with a two-dimensional method is implemented. Validity of the numerical scheme is established by comparison with existing one- and two-dimensional analytic solutions. 21 refs.

8465 **Porous media equivalent for networks of discontinuous fractures.** Long, J.C.S.; Remer, J.S.; Wilson, C.R.; Witherspoon, P.A. (Lawrence Berkeley Lab, CA, USA). *Water Resources Research;* **18**: No. 3, 645-658(Jun 1982).

The theory of flow through fractured rock and homogeneous anisotropic porous media is used to determine when a fractured rock behaves as a continuum. Field studies of fracture geometry are reviewed and a realistic, two-dimensional fracture system model is developed. The shape, size, orientation, and location of fractures in an impermeable matrix are random variables in the model. These variables are randomly distributed according to field data currently available in the literature. The fracture system models are subjected to simulated flow tests. The results of the flow tests are plotted as permeability 'ellipses.' 36 refs.

5802 Geophysics

REFER ALSO TO CITATION(S) 6844, 6981, 6982, 7032

8466 **Electrical conduction in mantle materials.** Shankland, T.J. (Los Alamos National Lab., NM). pp 256-263 of Evolution of the earth. Washington, DC; American Geophysical Union (1981). Contract W-7405-ENG-36.

It has been established for several years that electromagnetic methods readily provide information on lateral variations of physical properties in the earth's upper mantle, and that high electrical conductivities correlate well with other evidence of elevated mantle temperatures. This paper reviews the laboratory and theoretical evidence that connects conductivity with temperature, pressure, and the chemical activities of different mantle components.

8467 **The potential field around subsurface electrically excited conductors.** Lytle, R.J.; Okada, J.T.; Concepcion, C. (Lawrence Livermore Lab., CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Geoscience and Remote Sensing;* **GE-18**: No. 3, 240-243(Jul 1980). Contract W-7405-ENG-48.

A simple mathematical model has been developed for determining the depth and radius of an excited electrical conductor (e.g., a grout ball) located underground. The method uses voltage profiles, measured on the ground surface or in boreholes, and it is expected to be more accurate than conventional four-probe resistivity surveys.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 6963, 7051

8468 **(LA-UR—82-2167) Numerical simulation of fracture.** Margolin, L.G. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 9p. (CONF-830104—3). NTIS, PC A02/MF A01. Order Number DE82019532.

From International conference on constitutive laws for engineering materials: theory and application; Tucson, AZ, USA (10 Jan 1983).

A constructive model for brittle, and quasi-brittle materials is described. The Bedded Crack Model contains a microphysical description of fracture based on Griffith theory. The effect of cracks on material properties is described by effective modulus theory. Underlying the model is a statistical framework in which the evolution in time of a statistical distribution of cracks is calculated. The theory upon which the model is based is described. The model is implemented in a finite difference computer code. Our model is contrasted with the phenomenologic models usually found in computer codes. A computational simulation of the strain rate dependence of failure stress is presented and compared with laboratory data. A simulation of a gas gun experiment is presented, and the mechanism of spall described.

8469 **(NP—3900339) Calculation of equilibrium bifurcations of crystalline rocks.** Muehlhaus, H.B. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen). 20 Jun 1980. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE83900339.

Thesis.

Certain bifurcation problems which are relevant in rock mechanics can be solved with variational equations and material laws. For the construction of approximate solutions the finite element method is used. A criterium for the local convergence of the iterational process is given.

8470 **(SAND—81-1875C) Constitutive laws for rocks.** Butcher, B.M. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 13p. (CONF-830104—4). NTIS, PC A03/MF A01. Order Number DE82020034.

From International conference on constitutive laws for engineering materials: theory and application; Tucson, AZ, USA (10 Jan 1983).

Portions of document are illegible.

Increased attention to recovery of fossil fuels and concerns with regard to the storage of nuclear waste are generating renewed interest in development of constitutive laws for rocks. Many of these projects transcend the experience of traditional mining technology and therefore must rely on enhanced predictive capabilities for exploring the consequences of various environmental factors. Mechanical response of rocks under various states of stress is an important consideration in development of constitutive laws for rocks because many structures are located well below the earth's surface. In addition, many rocks initially compact slightly and then dilate during the later stages of deformation, a feature that makes them different than from other classes of engineering materials. Unlike other materials, rocks also contain pervasive natural fracture systems, which cause the rock mass as a whole to deform differently than one would expect on the basis of intact rock response. This paper reviews recent progress at Sandia National Laboratories in the development and application of several constitutive laws for rocks. Attention has focused on three different areas. First, a model for the creep of rock salt, a ductile rock will be described. Next, recent progress in modeling large rock masses containing systems of natural fractures or joints is addressed, and finally, two constitutive laws which evoke the concept of damage accumulation in rocks will be described.

8471 **(SAND—81-2443C) Constitutive model for ubiquitously jointed rock masses.** Johnson, R.L.; Thomas, R.K. (New Mexico Univ., Albuquerque (USA). Dept. of Civil Engineering; Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 8p. (CONF-830104—5). NTIS, PC A02/MF A01. Order Number DE82020182.

From International conference on constitutive laws for engineering materials: theory and application; Tucson, AZ, USA (10 Jan 1983).

A material constitutive model is presented for jointed rock masses which exhibit preferred planes of weakness. This model is intended for use in finite element computations. The present applications are computations involving stability of underground openings in hard rock, but the model seems appropriate for a variety of other static and dynamic geotechnical problems as well. Starting with the small strain finite element representations of a two-dimensional elastic body, joint planes are modeled in an explicit manner by direct modifications of the material stiffness matrix. A novel feature of the model presented is that joint set orientations, lengths and spacings are readily assigned through the sampling of a population distribution statistically determined from field measurement data. The result is that the fracture characteristics of the formations have the same statistical distribution in the model as is observed in the field. Two mechanisms of failure are modeled, including slip along existing joint planes and failure of the rock matrix by splitting

or shearing, each resulting in redistribution of stress due to modification of the material stiffness.

8472 **(SAND—82-1633C) Continuum model of inelastically deformed brittle rock based on the mechanics of microcracks.** Costin, L.S.; Holcomb, D.J. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 9p. (CONF-830104—1). NTIS, PC A02/MF A01. Order Number DE82018297.

From International conference on constitutive laws for engineering materials: theory and application; Tucson, AZ, USA (10 Jan 1983).

Portions of document are illegible.

For typical stress levels encountered in engineering and in much of geophysics, rock is a highly nonelastic brittle material, in which stress induced microcracks are principally responsible for the nonelastic behavior. When loading occurs beyond the previous peak differential stress (σ_1-σ_3), brittle rock behaves like an elastic-plastic material. At lower stress levels, brittle rock is more appropriately described as a para-elastic material. In the para-elastic regime, cyclic loading produces large hysteresis in strain and rock typically exhibits discrete memory. In this paper, a continuum model derived from the mechanics of microcracks is presented which describes the deformation of brittle rock under constant (creep) and cyclicly varying loads. The model employs the assumption that time and stress dependent microcrack growth is responsible for the plastic deformation. Because the rock matrix is essentially elastic, a quasi-elastic formalism is adopted in which the crack behavior is included as an internal state variable. Evolution of the crack density function is specified by generalizing the experimentally determined behavior of single cracks to that of a random ensemble of microcracks. Stress corrosion is assumed to be the dominant mechanism of time-dependent crack growth. In the para-elastic regime, the crack density is unchanging, however, the cracks open and close in response to varying stress levels producing hysteresis in strain and a memory of stress reversal points. By formulating the microcrack models into a continuum framework, a constitutive law is produced which describes both the elastic-plastic and para-elastic deformation regimes.

8473 **Geologic setting of the hillabee metavolcanic complex and associated strata-bound sulfide deposits in the appalachian piedmont of alabama.** Tull, J.F.; Stow, S.H. (Fla State Univ, Tallahassee, USA). *Economic Geology and the Bulletin of the Society of Economic Geologists;* 77: No. 2, 312-321(Mar-Apr 1982).

The frontal crystalline thrust sheet of the southern Appalachians in Alabama is a sequence of lower greenschist facies rocks known as the Talladega slate belt. This sequence is composed dominantly of metapelites and metasandstones, but it contains a distinctive metavolcanic complex, the Hillabee Greenstone, at the stratigraphic top. Sulfide deposits occur throughout the 170 km outcrop extent of the Hillabee. Low K tholeitic rocks constitute the bulk of the metavolcanic rocks; calc-alkaline quartz dacites are common. The Hillabee Greenstone appears to be the distal continentward portion of a volcanic arc system which developed during the middle Paleozoic in the southernmost Appalachians. The basal, dominantly pyroclastic part of the volcanic sequence is interlayered with the upper part of the Talladega Group, which locally contains a Lower to Middle Devonian fossil assemblage. Refs.

8474 **Some petrologic and oxygen isotopic relationships in the amulet mine, noranda, quebec, and their bearing on the origin of archean massive sulfide deposits.** Beaty, D.W.; Taylor, H.P. Jr. (Calif Inst of Technol, Pasadena, USA). *Economic Geology and the Bulletin of the Society of Economic Geologists;* 77: No. 1, 95-108(Jan-Feb 1982).

A concentrically zoned alteration pipe is present at the Amulet "A" Cu-Zn mine in the Archean Abitibi greenstone belt. The pipe consists of a central core zone of so-called "dalmatianite" surrounded by a zone of biotite-bearing grid-fracture alteration. Study of the dalmatianite indicates that these rocks experienced two episodes of recrystallization. Whole-rock /delta//sup 18/O values decrease from about 6 to 10 in most of the Abitibi belt to 5 to 7 in the country rocks surrounding the ore deposit, to values as low as 3.6 in the core of the dalmatianite zone. This oxygen isotopic zoning must have been produced by the hydrothermal activity, because the dehydration reactions associated with contact metamorphism cannot have affected /delta//sup 18/O by more than 0.5 per mil. Assuming an alteration temperature of 300/degree/sub p/lus or minus/50/degree/C and a water/rock ratio greater than two, the hydrothermal fluid must have had /delta//sup 18/O ?0.5/plus or minus/1.0. This indicates that the Amulet ore deposit formed from a hydrothermal fluid that had a /delta//sup 18/O value similar both to modern seawater and to the fluids which formed the Phanerozoic massive sulfide deposits of the Kuroko and Cyprus types. 51 refs.

5804 Geochemistry

REFER ALSO TO CITATION(S) 6964, 6981, 6982, 6984, 7060, 7210, 8059, 8060, 8228, 8309

8475 **(KFK-AFR—003, pp 23) On-line analysis of lead in lead-zinc flotation slurries.** Lubecki, A.; Wiese, K.; Winkler, K. May 1981. (In German). NTIS (US Sales Only), PC A04/MF A01.

From Seminar on radionuclide technology; Karlsruhe, F.R. Germany (13 May 1981).

8476 **(PB—82-207002) Determination of rare earth elements in igneous rocks by neutron activation analysis with group separation.** Moyes, A.B.; Whitley, J.E. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). 1975. 41p. NTIS, PC A03/MF A01.

In this report full details are given for the determination of all the stable rare earths in a procedure involving thermal neutron activation group separation, gamma - ray spectrometry with Ge(Li) detectors, data handling by computer, and determination of chemical yield by reactivation. The accuracy of the method is demonstrated with results obtained for a USGS standard rock. The way in which results may be interpreted is demonstrated with data obtained for a pantellerite, a comendite, and a quartz - soda trachyte.

8477 **(PB—82-207697) Determination of rare earths and other trace elements in igneous rocks by instrumental activation analysis.** Whitley, J.E. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). 1974. 25p. NTIS, PC A02/MF A01.

An introduction to the use of instrumental activation analysis for geochemical research is provided and the particular significance of rare earth abundances explained. Complete details are given of the experimental techniques used in the instrumental analysis of granitoid and ultrabasic rocks and results presented for an international standard granite (G2). Data for an albite-riebeckite granite from Nigeria is used to demonstrate the method of construction of relative rare earth abundance patterns and the manner in which the data may be interpreted.

5805 Oceanography

REFER ALSO TO CITATION(S) 8347

64 PHYSICS RESEARCH

REFER ALSO TO CITATION(S) 8602

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 8599, 8600

8478 **(UCRL—88329) Thermonuclear model for high energy transients.** Woosley, S.E. (California Univ., Santa Cruz (USA). Lick Observatory; Lawrence Livermore National Lab., CA (USA)). 1982. Contract W-7405-ENG-48. 21p. (CONF-820747—2). NTIS, PC A02/MF A01. Order Number DE83002814.

From Accreting neutron star conference; Garching, F.R. Germany (19 Jul 1982).

The thermonuclear model for x- and γ-ray bursts is discussed. Different regimes of nuclear burning are reviewed, each appropriate to a given range of (steady state) accretion rate. Accretion rates in the range 10^{-14} to 10^{-8} Msub solar y^{-1} all appear capable of producing x-ray transients of various durations and intervals. Modifications introduced by radiatively driven mass loss, the thermal inertia of the envelope, different burning mechanisms, and two-dimensional considerations are discussed as are difficulties encountered when the thermonuclear model is confronted with observations of rapidly recurrent bursts (≦ 10 min), and super-Eddington luminosities and temperatures. Results from a numerical simulation of a combined hydrogen-helium runaway initiated at pycnonuclear density are presented for the first time. The thermonuclear model for γ-ray bursts is also reviewed and updated, particularly with regard to the breakdown of the steady state hypothesis employed in previous work. Solely on the basis of nuclear instability, γ-ray bursts of various types appear possible for a very broad variety of accretion rates ($\sim 10^{-17}$ to $\sim 10^{-11}$ Msub solar y^{-1}) although other considerations may restrict this range. The thermonuclear model appears capable of yielding a great diversity of high energy transient phenomena for various accretion rates, magnetic field configurations, and neutron star envelope histories.

8479 **Grand unification and the fundamental problems of classical cosmology.** Turner, M.S. (Univ. of California, Santa Barbara). pp 222-247 of Second workshop on grand unification. Leveille, J.P.; Sulak, L.R.; Unger, D.G. (eds.). Boston, MA; Birkhaeuser (1981). Contract AC02-80ER10773.

From 2. workshop on grand unification; Ann Arbor, MI, USA (24 Apr 1981).

The accomplishments of classical cosmology are reviewed. In particular, the hot big bang model provides a reliable framework for understanding the evolution of the universe back to times at least as early as ~ 0.01 s after the big bang. At present there are (at least) six fundamental problems which have not yet been (completely) resolved. They are: (1) the origin of the baryon number-to-entropy ratio, (2) the origin of the isotropy, (3) the origin of the homogeneity and inhomogeneity, (4) the origin of the flatness, (5) the cosmological constant, and (6) the monopole problem. The role that grand unification has played, and may play in the resolution of these puzzles is discussed. Guth's inflationary universe, which addresses five of these six problems, is reviewed.

8480 **Silver isotopic anomalies in iron meteorites - Cosmic-ray production and other possible sources.** Reedy, R.C. (Los Alamos National Laboratory, Los Alamos, NM). pp 1169-1178 of Lunar and Planetary Science Conference. Vol. 2. Merrill, R.G. New York, NY; Pergamon Press (1980).

From 11. lunar and planetary science conference; Houston, TX, USA (Mar 1980).

Sources of excess Ag-107 observed in iron meteorites are investigated with emphasis on reactions of cosmic-ray particles with palladium. Cross sections for the production of the silver isotopes from palladium by energetic cosmic-ray particles are estimated to calculate spallogenic production rates relative to that of Mn-53 from iron. The upper limits for the production rates of Ag-107 and Ag-109 by energetic galactic cosmic-ray particles are 690 and 270 atoms/min/kg(Pd), respectively, and the maximum rate for making excess Ag-107 by spallation reactions is 400 atoms/min/kg(Pd). The excess Ag-107 cannot be produced by a long exposure to cosmic-ray particles, and because it is harder to make the amount of Pd-107 observed in the iron meteorites by an early intense proton irradiation than it is to make the Al-26 observed in other meteorites, it is concluded that the excess Ag-107 is due to the decay of nucleosynthetic Pd-107 in the iron meteorites.

8481 **Energetic particles in solar flares.** Ramaty, R. (NASA, Goddard Space Flight Center, Laboratory for High Energy Astrophysics, Greenbelt, Md.); Paizis, C. (California, University, Los Alamos Scientific Laboratory, Los Alamos; New Mexico Institute of Mining and Technology, Socorro, N. Mex.); Colgate, S.A. (Colorado, University, Boulder, Colo.); Dulk, G.A. (Space Research Astronomical Observatory, Utrecht, Netherlands); Hoyng, P. (Stanford University, Stanford, Calif.); Knight, J.W. (California, University, Berkeley, Calif.); Lin, R.P. (Australian National University, Canberra, Australia); Melrose, D.B. (Hawaii, University, Honolulu, Hawaii); Orrall, F. (Institute for Advanced Study, Princeton, N.J.). pp 117-185 of Solar flares: A monograph from Skylab Solar Workshop II. Sturrock, P.A. Boulder, CO; Colorado Associated University Press (1980).

The various manifestations of energetic particles in solar flares are examined, and possible mechanisms for the acceleration of these particles are considered. Hard X-ray observations and possible mechanisms for the production of the dominant form of solar energetic particles, electrons with energies between 10 and 100 keV, are discussed, with consideration of thin-target models, thick-target models and thick-target models with reverse currents, and first-phase acceleration mechanisms for energetic electrons emitting impulsive microwave and fast-drift Type III radio bursts as well as impulsive hard X rays, which are detected themselves 20 min after the flare at 1 AU are considered. Radio evidence on the number, energy and pitch-angle distributions of energetic particles produced during solar flares is summarized, and observations at 1 AU of proton and electron energy spectra, the proton/electron ratio and energetic particle events rich in He-3 from solar flares are discussed. Finally, consideration is given to gamma-ray evidence of nuclear reactions in flares and white-light flares.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 8268

8482 **(AD-A—114984/8) Nonlinear evolution of convecting plasma enhancements in the auroral ionosphere II. Small scale irregularities. Memorandum report.** Keskinen, M.J.; Ossakow, S.L. (Naval Research Lab., Washington, DC (USA)). 18 May 1982. 33p. NTIS, PC A03/MF A01.

The linear stability and nonlinear evolution of small scale density irregularities in local unstable regions of large scale convecting auroral plasma enhancements have been studied using analytical and numerical simulation techniques. Our results show that these small scale size irregularities are driven unstable primarily by the effects of convection and field aligned currents. Furthermore, we find that the density irregularities, in the nonlinear regime, in a plane nearly perpendicular to the magnetic field, resemble steepened striation-like structures (elongated in the north-south direction for equatorward convection) which can form and cascade from kilometer to tens of meter scale sizes on the order of an hour.

8483 **Sounding rocket program AERONOMY.** Offermann, D.; Thrane, E.V. Bonn, Germany; Bundesministerium fuer Forschung und Technologie (1981). 424p. (BMFT-FB-W—81-052).

The Energy Budget Campaign was an international campaign of ground based, balloon, and rocket borne experiments for the study of energetic processes in the mesosphere and lower thermosphere during geomagnetic disturbances. The campaign was performed in November/December 1980. Fifty rockets and fourteen balloons were launched in Northern Scandinavia. An extended network of ground based experiments was operated in widespread parts of Europe. The scientific objectives of the campaign and its experimental performance are described in 34 papers of this report.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 7914, 8195, 8731

8484 (DOE/ER/02875—17) Systematic study of muonic atoms in the A = 100 to A = 140 nuclear-mass regions (isotope and isotone shifts) and model-independent precision measurements of ground-state quadrupole moments of odd-A nuclei. Progress report No. 7, October 16, 1981-October 15, 1982. Steffen, R.M. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics). Oct 1982. Contract AC02-76ER02875. 30p. (COO—2875-17). NTIS, PC A03/MF A01. Order Number DE83002791.

Portions of document are illegible.

Until June 1982 all muonic x-ray experiments were performed at the Stopped Muon Channel (SMC) in experimental area A of LAMPF. The SMC channel, consisting of 3 bending magnets and 21 quadrupole magnets, is specifically designed for a clean muon beam and incorporates a long path for the decay of the pions. Recently a number of long-time experiments (rare decay modes of the muon, etc.) have been assigned to the SMC and running time for the muonic x-ray experiments has become very precious. For these reasons considerable time was spent in the summer of 1982 to study the feasibility of doing muonic experiments at the abandoned Biomed channel which has been designed for pion-irradiation therapy of cancer patients. Since the length of the Biomed channel is short, the available experimental area is close to the production target, and hence the neutron background in the experimental area is intolerably large (about 50 times larger than in the SMC experimental area). To reduce this background, the muonic x-ray detector and counter telescope arrangement was modified and surrounded by a concrete and steel shielding house of 1.5 feet minimum wall thickness. The dimensions of the house were 10' x 14' x 6' (H). The background was thus reduced to an acceptable level, even though the signal-to-noise ratio is still twice as large as in the SMC. Nevertheless, the Biomed channel is now usable for Muonic x-ray experiments that do not involve the observation of muonic x-rays of less than 0.5 MeV energy. The muonic x-ray experiments on ^{233}U described in this Progress Report have been performed at the Biomed channel.

8485 (DOE/ER/02887—6) Theoretical studies of highly-ionized species. Progress report, March 1 1982-February 28, 1983. Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA (USA)). Oct 1982. Contract AC02-76ER02887. 6p. NTIS, PC A02/MF A01. Order Number DE83002717.

Most of the effort during this period was devoted to calculations on charge transfer of multiply-charged systems in collisions with atomic hydrogen. The calculations have been extended to higher energies using a second-order distorted wave approximation. These calculations were made of C^{3+} and O^{3+} ions in atomic hydrogen. Fine-structure excitation by direct proton impact is also being studied, as is molecular photodissociation. (DLC)

8486 (IKF—41, pp 7-8) **K-ionization probability at $^{12}C(p,p)$ resonance scattering.** Meyerhof, W.E.; Astner, G.; Chemin, J.F.; Hofmann, D.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8487 (IKF—41, pp 22-24) **Study of the angular dependence of positron spectra in supercritical heavy ion collision systems.** Bokemeyer, H.; Folger, H.; Grein, H.; Ito, S.; Schwalm, D.; Trautmann, N.; Bethge, K.; Gruppe, A.; Schule, R.; Waldschmidt, M. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8488 (IKF—41, pp 25-27) **Strong dependence of the convoi electron emission on the time-of-flight of the projectiles through solids.** Latz, R.; Schader, J.; Frischkorn, H.J.; Hofmann, D.; Koschar, P.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8489 (IKF—41, pp 27-28) **Target thickness dependence of the total electron emission and the BEA electron yields from atomic and molecular heavy ions.** Latz, R.; Schader, J.; Frischkorn, H.J.; Hofmann, D.; Koschar, P.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8490 (IKF—41, pp 29-30) **Electron yields from heavy ion-solid collisions.** Boemmel, F.; Schmidt, W.; Saemann-Ischenko, G.; Frischkorn, H.J.; Koschar, P.; Latz, R.; Schader, J.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8491 (IKF—41, pp 31-32) **Influence of the Coulomb explosion of molecular ions on the Auger electron line shape after foil excitation.** Szabo, G.; Koschar, P.; Frischkorn, H.J.; Latz, R.; Schader, J.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8492 (IKF—41, pp 33-35) **Molecule impact ionization of simple systems.** Berenyi, D.; Koever, A.; Szabo, G.; Schader, J.; Latz, R.; Frischkorn, H.J.; Groeneveld, K.O.; Koschar, P. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8493 (IKF—41, pp 35) **Influence of the molecular structure on the inner-shell ionization in solid targets.** Frischkorn, H.J.; Hofmann, D.; Burkhard, M.; Schader, J.; Latz, R.; Koschar, P.; Groeneveld, K.O. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8494 (IKF—41, pp 36-39) **Mechanisms of the production of slow recoil ions in the high-energetic heavy ion collision.** Ingwersen, H.; Schmidt-Boecking, H.; Schuch, R.; Kelbch, S.; Ullrich, J. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8495 (IKF—41, pp 39-40) **Electron capture of slow multicharged Ne and Ar ions in He.** Ingwersen, H.; Justiniano, E.; Schmidt-Boecking, H.; Schuch, R.; Kelbch, S. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8496 (IKF—41, pp 41-43) **Impact parameter dependent ionization probability of L-subshells in strongly asymmetric ion-atom collisions.** Schuch, R.; Schmidt-Boecking, H.; Gray, T.J.; Ullrich, J.; Schadt, W.; Kelbch, S.; Stiebing, K.E.; Bethge, K.; Do, K.C. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8497 (IKF—41, pp 80-81) **Ion desorption from surfaces by electron collisions.** Rohwer, P.; Bethge, K.; Plappert, S.; Schuetze, W. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8498 (Juel—1744) Contributions to study of condensate phases and gaseous compounds. Hilpert, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie). Oct 1981. 287p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE82905924.

Portions of document are illegible.

High-temperature mass spectrometry with a Knudsen cell is compared to other methods for the study of condensed phases and gaseous compounds. The vaporization of the solid compounds of the binary systems Mg-Hg and Ca-Hg and of the ternary alloys with the composition $Hg_1 In_4 Mg/sub n/ (n = 0, 0.1, 0.2 ... 1)$ is

elucidated. The enthalpies of formation and the Gibbs free energies of formation are computed. For the system Hg-In-Mg the phase diagram was determined in the composition range Hg_1 In_4 Mg/sub 0-1/. The dissociation enthalpies of Cu_2, Hg_2, Cu_3, Ag_3, Au_3, DyCu, DyAg, DyAu, TbCu, and HoCu are determined. Dissociation enthalpies of the gaseous compounds between the rare earth metals and the elements of the 1B group are predicted. The ionic molecules NaI, $(NaI)_2$, and $(NaI)_3$ were studied upon vaporizing NaI(s). Enthalpies of dimerization and trimerization were determined. By applying the Pauling model for alkali halogenides, the experimental enthalpy of trimerization could be verified and the trimerization enthalpies and molecular parameters of eight additional alkali halogenide trimers are predicted.

8499 (Juel-Spez—146, pp 41-42) **Charge transfer atomic collision by BIG KARL.** Styczen, B.; Gaul, G.; Katayama, I.; Berg, G.P.A.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Oelert, W.; Rogge, M.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8500 (Juel-Spez—146, pp 93) **Semiclassical treatment of light-ion induced alignment of the L_0-subshell in heavy atoms.** Roesel, F.; Trautmann, D.; Baur, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8501 (Juel-Spez—146, pp 94) **Recoil effects in atomic inner shell ionization.** Roesel, F.; Trautmann, D.; Baur, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8502 (LBL—14552) **Infrared-emission spectroscopy of CO on Ni.** Chiang, S.; Tobin, R.G.; Richards, P.L. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 6p. (CONF-820977—2). NTIS, PC A02/MF A01. Order Number DE83002328.

From 3. internatonal conference on vibrations at surfaces; Pacific Grove, CA, USA (1 Sep 1982).

We report the first observation of thermally emitted infrared radiation from vibrational modes of molecules adsorbed on clean, single-crystal metal surfaces. The observation of emission from CO adsorbed on Ni demonstrates the surface sensitivity of a novel apparatus for infrared vibrational spectroscopy, with a resolution of 1 to 15 cm^{-1} over the frequency range from 330 to 3000 cm^{-1}. A liquid-helium-cooled grating spectrometer measures the thermal radiation from a room-temperature, single-crystal sample, which is mounted in an ultrahigh-vacuum system. Measurements of frequencies and linewidths of CO on a single-crystal Ni sample, as a function of coverage, are discussed.

8503 (LBL—14917) **Metal-atom fluorescence from the quenching of metastable rare gases by metal carbonyls.** Hollingsworth, W.E. (Lawrence Berkeley Lab., CA (USA)). Nov 1982. Contract AC03-76SF00098. 134p. NTIS, PC A07/MF A01. Order Number DE83004118.

Portions of document are illegible. Thesis.

A flowing afterglow apparatus was used to study the metal fluorescence resulting from the quenching of metastable rare-gas states by metal carbonyls. The data from the quenching or argon, neon, and helium by iron and nickel carbonyl agreed well with a restricted degree of freedom model indicating a concerted bond-breaking dissociation.

8504 (LBL—15092) **Electronic energy transfer from molecules to metal and semiconductor surfaces, and chemisorption-induced changes in optical response of the nickel (111) surface.** Whitmore, P.M. (Lawrence Berkeley Lab., CA (USA)). Oct 1982. Contract AC03-76SF00098. 197p. NTIS, PC A09/MF A01. Order Number DE83003757.

Thesis.

The evolution of molecular excited states near solid surfaces is investigated. The mechanisms through which energy is transferred to the surface are described within a classical image dipole picture of the interaction. More sophisticated models for the dielectric response of the solid surface add important new decay channels for the energy dissipation. The predictions and applicability of three of these refined theories are discussed.

8505 (MPE—175) **Time-of-flight spectrometer measurement of charge transfer and energy losses in carbon foils at ions in the energy range from 10 to 300 keV.** Luhn, A. (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik). Mar 1982. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750974.

The present paper deals with the measurement of energy losses and the charge states of ions behind thin carbon foils. Thereby the energy range from 10 to 300 keV per charge was considered.

8506 (ORNL—5921-Vol.1) **Bibliography of atomic and molecular processes. Volume 1, 1978-1981.** Barnett, C.F.; Crandall, D.H.; Farmer, B.J. (comps.). (Oak Ridge National Lab., TN (USA)). Oct 1982. Contract W-7405-ENG-26. 630p. NTIS, PC A99/MF A01. Order Number DE83002583.

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This annotated bibliography lists 10,676 works on atomic and molecular processes reported in publications dated 1978-1981. Sources include scientific journals, conference proceedings, and books. Each entry is designated by one or more of the 114 categories of atomic and molecular processes used by the Controlled Fusion Atomic Data Center, Oak Ridge National Laboratory to classify data. Also indicated is whether the work was experimental or theoretical, what energy range was covered, what reactants were investigated, and the county of origin of the first author. Following the bibliographical listing, the entries are indexed according to the categories and according to reactants within each subcategory.

8507 (PB—82-210519) **The absorption and emission of radiation by the collision complex. Final report.** Gallagher, A. (National Bureau of Standards, Washington, DC (USA)). 1982. 9p. Pub. in Proceedings of International Conference on the Physics of Electronic and Atomic Collisions (12th), Gatlinburg, TN, July 15-21, 1981, Paper in Physics of Electronic and Atomic Collisions, p403-411 1982.

The absorption and emission of radiation by interacting atoms has been used for many years to study atomic collisions. Generally called line broadening, it is actually a study of the diatomic collision complex. It is also a form of molecular spectroscopy, but it involves free rather than bound states, so it requires the study of intensity information rather than the wavelengths of bound-bound lines. This field is now approaching a very exciting prospect of studying the collision complex in reactive collisions. It has long been recognized that the same ideas and principles normally applied to two interacting atoms can also be applied to an atom-molecule or triatomic interaction. However, the complexity is very much greater. Thus, whereas line broadening by two colliding atoms has been studied for many decades in many laboratories, triatomics are just beginning to be studied in only a few laboratories. Yet this type of measurement holds great promise as a powerful diagnostic os chemical reactions and other atom-molecule collision processes.

8508 (PNL-SA—10559) **Multiple ionization of atomic targets by proton impact.** Toburen, L.H.; DuBois, R.D.; Manson, S.T. (Pacific Northwest Lab., Richland, WA (USA); Georgia State Univ., Atlanta (USA)). Oct 1982. Contract AC06-76RL01830. 19p. (CONF-821123—5). NTIS, PC A02/MF A01. Order Number DE83003468.

From 7. conference on the application of accelerators in research and industry; Denton, TX, USA (8 Nov 1982).

Portions of document are illegible.

We have combined experimental measurements of multiply charged ion production, doubly differential electron emission cross sections and Auger electron spectra produced in fast proton noble-gas collisions with theoretical inner and outer shell ionization cross sections in an effort to provide a consistent description of the ionization process. A detailed analysis is provided for 1-4 MeV proton ionization of krypton. Our measured relative yields of Kr^{+2} and

Kr^{+3} ions are in approximate agreement with photoionization results of Krause and Carlson. If we assume nearly half of the 3d vacancies created in Kr are filled through multiple (3 dNNN) Auger transitions, the M-subshell ionization cross sections that we derive from our Auger electron spectra are in good agreement with theoretical calculations. The absolute yields of Kr^{+2} and Kr^{+3} are, however, a factor of 2 smaller than the calculated values.

8509 **Vibrational-rotational-translational energy transfer in Ar + OH. Quasiclassical trajectory state-to-state cross sections.** Thompson, D.L. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **86**: No. 13, 2538-2549(24 Jun 1982).

A study has been made of the energy transfer in Ar + OH using quasiclassical trajectories and a pairwise additive potential. The calculations were carried out for initial vibrational states nu/sub i/ = 0, 2, and 4 and initial rotational states J_1 = 0, 10, and 20 for initial relative translational energies 0.2, 0.5, and 1.0 eV. State-to-state cross sections were computed to provide information on pure-rotational energy transfer, vibration-rotation (V-R) transitions, and vibrational relaxation. Energy transfer in collisions of Ar with highly excited OH involves multiple-quantum V-R transfers. As the vibrational energy is collisionally decreased, the rotational energy is increased. Varying the collision energy has a minor influence on V-R transfer. For J/sub i/ = 0 there is essentially no vibrational energy effect on pure-rotational energy transfer for 0.2 to 1.0-eV collision energy. For the larger J/sub i/ there is both a vibrational and translational energy effect on the rotational energy transfer. Vibrational relaxation cross sections are strongly dependent on J/sub i/. 19 figures, 6 tables.

8510 **Resonant photoemission of atomic Mn.** Bruhn, R.; Schmidt, E.; Schroeder, H.; Sonntag, B. Hamburg, Germany; Deutsches Elektronen-Synchrotron (DESY) (1982). 10p. (DESY-SR—82-06). Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany.

The photoemission of atomic Mn has been obtained in the photon energy range 40 eV to 56 eV. The strong coupling of the 3p and 3d excitations leads to a resonant enhancement of the $3d^5$ (^{6}S) 4s, $3d^5$ (^{4}X) 4s, $3d^4$ (^{5}D) $4s^2$ and $3d^4$ (^{5}D) 4s nl photoemission lines above the 3p threshold.

8511 **Heavy ion equilibrium in T_2 gas.** Souers, P.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Journal of Physics B: Atomic and Molecular Physics;* **14**: No. 11, L387-L390(14 Jun 1981).

Mass spectroscopic studies of electron-irradiated hydrogen gas have been extrapolated to low temperatures and combined with recent T_2 electrical data. The resulting calculations predict a maximum concentration of 10^8 $T_3{}^+$ ions/cm^3 at 26 K. Using a typical mass spectrometer orifice and a liquid T_2 reservoir, 10^6 ions/s could be removed from the gas phase for study. At lower temperatures, the diminishing vapour pressures decrease the ion density.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 7781

8512 **(KAPL—4152) Mathematical foundations for numerical solution of Navier-Stokes equations.** Wachspress, E.L. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Jul 1982. Contract AC12-76SN00052. 61p. NTIS, PC A04/MF A01. Order Number DE83002539.

Mathematical foundations for the TEACH/TURF numerical solution of the Navier-Stokes equation are explored. Properties of the discrete equations sufficient to guarantee convergence of the iterative procedure are described. It is proved that a problem-dependent range of underrelaxation parameters exists for which the pressure-velocity iteration of the linearized equations is convergent. Convergence of the iteration on the nonlinearity is not established. It is observed that turbulence modeling affects the nonlinear iteration and that existence of a stable time-averaged solution to the turbulent flow equations must be examined. A crucial property required of the discrete equations for convergence is developed.

8513 **Thermal-transient-induced pipe stratification.** Kasza, K.E.; Bobis, J.P. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 675(Nov 1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

8514 **On 'general conservation equations for multiphase systems: 1. averaging procedure' by M. Hassanizadeh and W. G. Gray.** Narasimhan, T.N. (Lawrence Berkeley Lab., CA). *Advances in Water Resources;* **3**: 143(Sep 1980).

In their paper on general conservation equations, Hassanizadeh and Gray correctly point out that when an averaging operation involves integration, the integrand multiplied by the infinitesimal volume must be an additive quantity. Whether a quantity possesses the additive property or not should indeed stem from physical considerations. The additivity requirement has considerable significance in diffusion type problems.

8515 **The multigrid method for semi-implicit hydrodynamics codes.** Brandt, A. (Weizmann Inst. of Sciences, Rehobot, Israel); Dendy, J.E. Jr.; Ruppel, H. *Journal of Computational Physics;* **34**: No. 3, 348-370(1 Mar 1980).

The multigrid method is applied to the pressure iteration in both Eulerian and Lagrangian codes, and computational examples of its efficiency are presented. In addition a general technique for speeding up the calculation of very low Mach number flows is presented. The latter feature is independent of the multigrid algorithm.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 8237, 8599

8516 **(BONN-HE—82-4) Electroproduction of πi mesons at forward and backward direction in the region of the D_{13}(1520) and F_{15}(1688) resonances.** Breuker, H.; Burkert, V.; Ehses, E.; Hartfiel, U.; Knop, G.; Koepke, L.; Leenen, M.; Mehnert, W.; Rosenberg, M.; Samel, A. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Feb 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750666.

We report on measurements of the reaction $ep \rightarrow en\pi^+$ in the region of the D_{13}(1520) and F_{15}(1688) resonances. At an invariant four-momentum transfer $q^2 = 0.3$ (GeV/c)^2 the outgoing pion was detected in the forward and backward directions. The values of the helicity-1/2-partial wave amplitudes A_2-(D_{13}(1520)) and A_3-(F_{15}(1688)) are determined from these measurements. A comparison of the results with single quark transition models is made..

8517 **(DESY—81-063) QCD effects in hadron production by high energy muons. Results of the European Muon Collaboration.** Gayler, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1981. 14p. (CONF-810760—19). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750364.

From International conference on high energy physics; Lisbon, Portugal (9 Jul 1981).

Results are presented on hadronic final states in 280 GeV μp interactions. The patterns of p^{2}sub(perpend. to)-distributions, angular energy flow and Σ p^{2}sub(perpend. to)sub(in/out) distributions are consistent with first order QCD calculations. At large fractional hadronic energy excessive transverse momenta are observed indicating effects of intrinsic transverse momenta.

8518 **(DESY—81-069) π0 production by e^+e^- annihilation at 14 and 34 GeV c.m. energy.** Brandelik, R.; Braunschweig, W.; Gather, K.; Kirschfink, F.J.; Luebelsmeyer, K.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G.; Schmitz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750365.

The process $e^+e^- \rightarrow \pi^0$ + anything has been measured at c.m. energies of 14 and 34 GeV for π^0 energies between 0.5 and 4

GeV. The ratio of π^0 to π^{+-} production for π momenta between 0.5 and 1.5 GeV/c is measured to be 2sigma(π^0)/(sigma(π^+) + sigma(π^-)) = 1.3 +- 0.4(1.2 +- 0.4) at 14(34) GeV. The scaled cross section (s/β) dsigma/dx when compared with lower energy (4.9-7.4 GeV) π^0 data indicates a substantial scaling violation.

8519 **(DESY—81-072) Observation of a charge asymmetry in $e^+e^- \rightarrow \mu^+\mu^-$.** Bartel, W.; Cords, D.; Dittmann, P.; Eichler, R.; Felst, R.; Haidt, D.; Krehbiel, H.; Meier, K.; Naroska, B.; O'Neill, L.H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750366.

The angular distribution and the s dependence of the total cross-section for the process $e^+e^- \rightarrow \mu^+\mu^-$ have been measured using the JADE detector at PETRA. After radiative corrections, a forward-backward asymmetry of -(11.8 +- 3.8)% was observed at an average centre of mass energy of 33.5 GeV. For comparison, an asymmetry of -7.8% is expected on the basis of the standard Glashow-Salam-Weinberg model.

8520 **(DESY—81-074) Recent results from PETRA.** Buerger, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); International Union of Pure and Applied Physics). Oct 1981. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750441.

From Symposium on lepton and photon interactions at high energies; Bonn, Germany, F.R. (24 - 29 Aug 1981).

Recent results on the search for new particles, new thresholds and on properties of B-mesons are reported. No new particle has been observed. More stringent limits on production cross sections have been obtained.

8521 **(DESY—81-076) Recent results from DORIS.** Bienlein, J.K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Nov 1981. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750442.

New data on bottonium spectroscopy concern the search of $\gamma\gamma$-cascade decays of UPSILON' (UPSILON' $\rightarrow \gamma\gamma$UPSILON, UPSILON $\rightarrow e^+e^-$ or $\mu^+\mu^-$) and yield one event giving a branching ratio <= 7%. The UPSILON direct hadronic decays are used as a gluon factory and the gluon fragmentation is compared to quark fragmentation. Sphericity (and other topological quantities), charged multiplicity, particle correlations, γ-fraction, and inclusive spectra are equal. The phenomenological differences come from the different decay mechanisms (CONT $\rightarrow$ 2 quark jets vs. UPSILON $\rightarrow$ 3 gluon jets). The only difference seen is an enhanced anti p yield of UPSILON and UPSILON' decays. In a narrow energy scan in the energy regions 7.4-7.5 and 8.6-9.4 GeV no new resonance or new step is seen.

8522 **(DESY—82-002) Charge asymmetry and weak interaction effects in $e^+e^- \rightarrow \mu^+\mu^-$ and $e^+e^- \rightarrow$ tau$^+$tau$^-$.** Brandelik, R.; Braunschweig, W.; Gather, K; Kirschfink, F.J.; Luebelsmeyer, K.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G.; Schmitz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750670.

We have measured, at an average centre-of-mass energy of 34.22 GeV a forward-backward charge asymmetry in the reaction $e^+e^- \rightarrow \mu^+\mu^-$ of value -0.161 +- 0.032. This demonstrates the existence of an axial vector neutral current with coupling strength of gsup(e)sub(a)gsup(μ)sub(a) = 0.53 +- 0.10. We have also obtained a limit on the vector coupling strength of gsup(e)sub(v)gsup(μ)sub(v) < 0.12. The Weinberg angle is found to be sin^{2}THETAsub(W) = 0.29sup(+0.09)sub(-0.11). From the reaction $e^+e^- \rightarrow$ tau$^+$tau$^-$ we have found gsup(e)sub(a)gsup(tau)sub(a) < 0.34, gsup(e)sub(v)gsup(tau)sub(v) < 0.55.

8523 **(DESY—82-004) Study of two photon production of two-body final states with invariant mass greater than 2.0 GeV.** Berger, C.; Genzel, H.; Grigull, R.; Lackas, W.; Raupach, F.; Wagner, W.; Klovning, A.; Lillestoel, E.; Ackermann, H.; Alexander, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750667.

We have measured the electron, muon, and charged-hadron pair production rates in two-photon interactions for invariant masses above 2.0 GeV over a large range of momentum transfers. The cross sections for electron and muon pairs show good agreement with the QED predictions at both small and large momentum transfers. The observed rate of hadron production is less than 6% of the rate that QED predicts for point-like hadrons, consistent with recent leading-order QCD calculations.

8524 **(DESY—82-007) Measurement of the reaction $e^+e^- \rightarrow e^+e^-$n' and the radiative width GAMMAsub(eta'$\rightarrow\gamma\gamma$) at PETRA.** Bartel, W.; Cords, D.; Dittmann, P.; Eichler, R.; Felst, R.; Haidt, D.; Krehbiel, H.; Meier, K.; Naroska, B.; O'Neill, L.H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750672.

The reaction $e^+e^- \rightarrow e^+e^-$eta' has been observed in the JADE experiment at PETRA, by detecting the final state $\pi^+\pi^-\gamma$, resulting from the decay eta' $\rightarrow \gamma$rho^0. The cross section was measured to be sigma($e^+e^- \rightarrow e^+e^-$eta') = 2.2 +- 0.2 (stat.) +- 0.4 (syst.) nb, yielding the radiative width GAMMAsub(eta'$\gamma\gamma$) = 5.0 +- 0.5 (stat.) +- 0.9 (syst.) keV.

8525 **(DESY—82-008) Determination of the radiative widths of the n' and A_2 from two photon exchange production.** Behrend, H.J.; Chen, C.; Fenner, H.; Field, J.H.; Guempel, U.; Schroeder, V.; Sindt, H.; D'Agostini, G.; Apel, W.D.; Banerjee, S. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750673.

From the two photon exchange processes $e^+e^- \rightarrow e^+e^-$eta' (958) $\rightarrow e^+e^-$rhosup(o)γ and $e^+e^- \rightarrow e^+e^-A_2$ (1310) $\rightarrow e^+e^-\pi^+\pi^-\pi$sup(o) observed using the CELLO detector at PETRA the radiative widths of the eta' and A_2 have been determined with the results: GAMMAsub($\gamma\gamma$)(eta')= GAMMAsub($\gamma\gamma$)(eta') = 5.4 +- 1.0 [stat.] +- 0.7 [syst.] keV GAMMAsub($\gamma\gamma$)(A_2) = 0.59 +- 0.14 [stat.] sup(+0.31)sub(-0.08) [syst.] keV.

8526 **(DESY—82-009) Charged pion production in e^+e^- annihilation at 14, 22 and 34 GeV c.m. energy.** Brandelik, R.; Braunschweig, W.; Gather, K.; Kirschfink, F.J.; Luebelsmeyer, K.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G.; Schmitz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750675.

The inclusive production of π^{+-} mesons in e^+e^- annihilation has been measured at c.m. energies of 14, 22 and 34 GeV for pion momenta between 0.3 and 10 GeV/c and decreases to about 50% at high momenta. The scaled cross sections (s/β) dsigma/dx at 14, 22 and 34 GeV as well as the 5.2 GeV data from DASP have a rather similar x dependence. After integration over the x range from 0.2 to 0.6 the cross sections indicate a monotonic decrease with increasing centre-of-mass energy.

8527 **(DESY—82-010) Measurement of sigmasub(tot) ($e^+e^- \rightarrow$ hadrons) for c.m. energies between 12.0 and 36.7 GeV.** Brandelik, R.; Braunschweig, W.; Gather, K.; Kirschfink, F.J.; Luebelsmeyer, K.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G.; Schmitz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750674.

The ratio R = sigma(e^+e^- $\rightarrow$ hadrons)/sigmasub($\mu\mu$) was measured between 12.0 and 36.7 GeV c.m. energy W with a precision of typically +- 5.2%. R is found to be constant with an aver-

age of R = 4.01 +- 0.03 (stat.) +- 0.20 (syst.) for W >= 14 GeV. Quarks are found to be pointlike, the mass parameter describing a possible quark formfactor being larger than 186 GeV. Fits including QCD corrections and a weak neutral current contribution are presented.

8528 **(DESY—82-011) Recent results in electron-positron and lepton-hadron interactions.** Wiik, B.H.; Mess, K.H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 299p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE82750683.

These lectures will start with a few remarks on detectors and beams used to study e^+e^- annihilation and deep inelastic lepton-nucleon interactions. The main part of the lectures will discuss recent results obtained from a study of these processes including a discussion on the result of recent particle searches. The picture which emerges from these data is consistant with what has become known as the standard model. However, it is important to bear in mind that the experiments so far have only investigated masses which are small compared to 100 GeV/c^2, the characteristic mass of the weak interaction. The new generation of e^+e^- and ep collider will allow us to extend these measurements into a mass range above 100 GeV/c^2, and thus provide answers to many of the questions confronting the standard model.

8529 **(DESY—82-013) Scale breaking in inclusive charged particle production by e^+e^- annihilation.** Brandelik, R.; Braunschweig, W.; Gather, K.; Kirschfink, F.J.; Luebelsmeyer, K.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G.; Schmitz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750708.

The scaled cross section sdsigma/dxsub(p) for inclusive charged particle production in e^+e^- annihilation has been studied for c.m. energies W between 12.0 and 36.7 GeV. Scale breaking is observed. For xsub(p) > 0.2 the cross section decreases by approx. equal to 20% when W increases from 14 to 35 GeV. The production angular distribution was used to separate the longitudinal and transverse cross section contributions and to determine the ratio of the structure functions manti W_1 and νanti W_2.

8530 **(DESY—82-014) Upper limit on beauty lifetime and lower limit on weak mixing angles.** Bartel, W.; Cords, D.; Dittmann, P.; Eichler, R.; Felst, R.; Haidt, D.; Krehbiel, H.; Meier, K.; Naroska, B.; O'Neill, L.H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750709.

Muons from a multihadron sample are used to determine an upper limit tau < 1.4 x 10^{-12} sec (95% CL) on the lifetime of beauty particles. The data are obtained with the JADE detector at PETRA. The result is interpreted within the standard model.

8531 **(DESY—82-016) Observation of four-jet structure in e^+e^--annihilation at $\sqrt{s}$ = 33 GeV.** Bartel, W.; Cords, D.; Dittmann, P.; Eichler, R.; Felst, R.; Haidt, D.; Krehbiel, H.; Meier, K.; Naroska, B.; O'Neill, L.H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750711.

Topological distributions of hadrons from the reaction e^+e^- → hadrons are studied at center of mass energies of about 33 GeV. The experimental distributions in the parameters acoplanarity and tripodity, both sensitive to events with a four-jet structure, show significant deviations from the expectations for two- and three-jet events. They can be described well by the inclusion of four-jet events. The relative magnitude of the observed effect indicates second order QCD as its probable origin.

8532 **(DESY—82-017) Analysis of the charged and neutral energy flow in e^+e^- hadronic annihilation at 34 GeV, and a determination of the QCD effective coupling constant.** Behrend, H.J.; Chen, C.; Fenner, H.; Field, J.H.; Schroeder, V.; Sindt, H.; D'Agostini, G.; Apel, W.D.; Banerjee, S.; Bodenkamp, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 9p. (LAL—82/06). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750712.

Using both charged and neutral components, 2600 multihadronic e^+e^- annihilation events, recorded at 34 GeV by the CELLO detector at PETRA, have been analysed in a calorimetric approach. The fraction of energy carried by gamma rays is measured to be fsub(γ) = 26.0 +- 0.4 (stat) +- 4.0 (syst) %. The neutral energy flow is seen to follow closely the overall energy flow. From the corrected oblateness distribution, a first order determination of αsub(s) is performed. The result is αsub(s) = .16 +- .01 (stat) +- .03 (syst).

8533 **(DESY—82-018) Measurement of inclusive γ and π^0 spectra and a comparison of the neutral and charged components in hadronic events in e^+e^- annihilation at 34 GeV.** Behrend, H.J.; Chen, C.; Fenner, H.; Field, J.H.; Schroeder, V.; Sindt, H.; D'Agostini, G.; Apel, W.D.; Banerjee, S.; Bodenkamp, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750713.

The photonic part of multihadronic e^+e^- annihilation events has been analyzed at a c.m. energy of 34 GeV. The photonic energy fraction per event is determined to be fsub(γ) = 0.251 +- 0.003 (stat.) +- 0.04 (syst.). The neutral and charged components of the events are analyzed separately revealing close similarity in thrust axis directions and momentum distributions in agreement with the hypothesis that most photons result from π^0 decay. π^0's are reconstructed separately and used to determine the inclusive cross section. Comparing these cross sections with lower energy data from SPEAR we find some indication for scaling violation.

8534 **(DESY—82-019) Measurement of the reaction $e^+3^- \rightarrow \mu^+\mu^-$ for 14 <= $\sqrt{S}$ <= 36,4 GeV.** Behrend, H.J.; Chen, C.; Fenner, H.; Field, J.H.; Schroeder, V.; Sindt, H.; D'Agostini, G.; Apel, W.D.; Banerjee, S.; Bodenkamp, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750714.

The reaction ($e^+e^- \rightarrow \mu^+\mu^-$) has been measured between $\sqrt{S}$ = 14.0 GeV and $\sqrt{S}$ = 36.4 GeV. The total cross section result is in good agreement with the QED prediction and the following Λ values have been obtained: Λsub(+) = 186 GeV, Λsub(-) = 101 GeV. The angular distribution at high energy (<$\sqrt{S}$> = 34.2 GeV) shows a fitted charge asymmetry of -.064 +- .064 in agreement with the W-S model prediction of -0.092, corresponding to an axial coupling parameter a^2 = 4 g^2sub(a) = 0.69 +- 0.69.

8535 **(DESY—82-020) Measurement of $e^+e^- \rightarrow$ tau$^+$tau$^-$ at high energy and properties of the tau lepton.** Behrend, H.J.; Chen, C.; Fenner, H.; Field, J.H.; Schroeder, V.; Sindt, H.; D'Agostini, G.; Apel, W.D.; Banerjee, S.; Bodenkamp, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1982. 7p. (LAL—82/08). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750715.

The e^+e^- → tau$^+$tau$^-$ process has been measured using the CELLO detector at a mean total centre of mass energy of 34.2 GeV using essentially all the decay channels of the tau lepton. The measured cross section yields Rsub(tau) = 1.03 +- .05 (stat) +- .07 (syst). Topological branching fractions are given for tau → 1, 3 or 5 charged tracks. The angular distribution shows a clear 1 + $\cos^2$THETA dependence with a forward-backward asymmetry of -.103 +- .052 corresponding to an axial-vector coupling asub(tau) of the tau to the weak neutral current given by asub(tau) = -1.12 +- .57.

8536 **(DESY—82-021) Scalar lepton search with the CELLO detector at PETRA.** Behrend, H.J.; Chen, C.; Fenner, H.; Field, J.H.; Schroeder, V.; Sindt, H.; D'Agostini, G.; Apel, W.D.; Banerjee, S.; Bodenkamp, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1982. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750716.

We report on the search for 'supersymmetric' scalar leptons conducted with the CELLO detector, at the PETRA e^+e^- storage ring. 11.1 pb^{-1} of high energy data were analysed (33 GeV < $\sqrt{s}$ < 36.72 GeV). At a 95% C.L., the existence of a scalar e is ruled out for masses between 2 GeV and 16.8 GeV; correspondingly, a scalar μ is excluded between 3.3 GeV and 16 GeV, and a scalar tau between 6 GeV and 15.3 GeV, as well as between the tau mass and 3.8 GeV.

8537 **(DESY—82-027) Search for new particles at PETRA.** Boehm, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750985.

Intensive searches for new particles have been performed in e^+e^- annihilation at PETRA at energies up to 36.7 GeV. No new quark and no new lepton have been found. Also the existence of spin zero partners of leptons predicted by supersymmetric theories is excluded up to masses of about 16 GeV. Furthermore, no charged Higgs particles or technipions have been observed.

8538 **(DESY—82-032) Electroweak coupling constants in the leptonic reactions $e^+e^- \rightarrow e^+e^-$ and $e^+e^- \rightarrow \mu^+\mu^-$ and search for scalar leptons.** Brandelik, R.; Braunschweig, W.; Gather, K.; Kirschfink, F.J.; Luebelsmeyer, K.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G.; Schmitz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751058.

A high statistics experiment was performed on Bhabha scattering at energies between 14 and 34 GeV. Good agreement with QED was observed. The combined data on Bhabha scattering and μ pair production were found to agree with the standard theory of electroweak interaction giving sin²THETA = 0.27sup(+0.06)sub(-0.07). Assuming for the Z^0 mass a value of 90 GeV the leptonic weak coupling constants were determined to g²sub(V) = -0.04 +- 0.06 and g²sub(A) = 0.35 +- 0.09. A search for scalar leptons sets lower limits on the mass of scalar electrons of Msub(ssub(e)) > 16.6 GeV and of scalar muons of Msub(ssub(μ)) > 16.4 GeV.

8539 **(DESY-PLUTO—81/01) Study of the production of heavy leptons in the energy range of 9.4-31.6 GeV.** Meyer, O. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Gesamthochschule Wuppertal (Germany, F.R.). Fachbereich 8 - Naturwissenschaften 1 - Physik). Feb 1981. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750705.

Thesis.

The production of tau-pairs has been studied with the magnetic detector PLUTO at the storage rings DORIS and PETRA. Data are presented for values of centre of mass energy between 9.4 and 31.6 GeV. The measured cross section is found to be in good agreement with the predictions of QED. The lower limits for the cutoff parameters Λsub(+) > 79 GeV and Λsub(-) > 63 GeV (95% CL) are determined. This corresponds to a test of the point-like nature of the tau down to distances of r < 3 x 10^{-16} cm. The branching ratios for tau decay have been determined and are consistent with the world averages and with the theoretical predictions. A search has been made for the production of a new sequential heavy lepton. A lower limit of 14.5 GeV/c² for the mass of a new charged lepton with standard decay modes has been obtained with 95% CL.

8540 **(DOE/ER/02504—T2) High-energy-accelerator and colliding-beam user group. Progress report, March 1, 1982-February 28, 1983.** (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1983. Contract AC05-76ER02504. 140p. NTIS, PC A07/MF A01. Order Number DE83003198.

Portions of document are illegible.

Three major areas are covered, progress report, budget report, and proposed research program. The progress report covers the following major topics: electron-positron interactions at PETRA with PLUTO; neutrino-deuterium interactions in the 15 foot bubble chamber; hadron jet physics experiment at Fermilab; status of neutrino-electron and proton-proton scattering experiments at Los Alamos; and work on future projects. (GHT)

8541 **(DOE/ER/70149—T2) High-energy physics study. Final report.** Schultz, J. (California Univ., Irvine (USA). Dept. of Physics). 1978. Contract AT03-76ER70149. 16p. NTIS, PC A02/MF A01. Order Number DE83001516.

A final report is presented on the activities of Task B of the Experimental High Energy Physics Group at the University of California, Irvine. The report deals primarily with a description of and results from the Task B group's major project, the DELCO experiment at the Stanford Linear Accelerator Center. This experiment consisted of a study of direct electrons produced in e^+e^- collisions at SPEAR. Also discussed are two other experiments engaged in by this group: a study of particular final states produced by long-lived neutral kaons in hydrogen, and a search for massive muon pairs produced by K/sub L//sup o/ on a copper target.

8542 (Juel-Spez—146, pp 69-71) **Search for the two-photon decay of a light penetrating particle - axion - at a nuclear reactor.** Bechteler, H.; Faissner, H.; Yogeshwar, R.; Frenzel, E.; Koch, H.R.; Schult, O.; Seyfarth, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8543 **(RL—82-001) Particle physics experiments 1981.** Rousseau, M.D.; Stuart, G. (Science Research Council, Chilton (UK). Rutherford and Appleton Labs.). 1982. 219p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE82702890.

Unedited contributions from each experiment.

Work carried out in 1981 on 54 experiments approved by the Particle Physics Experiments Selection Panel is described in unedited contributions from each experiment.

8544 **(RL—82-008) Determination of the α parameter for the decay $\Xi^- \rightarrow \Lambda\pi^-$.** Biagi, S.F.; Britten, A.J.; Bourquin, M. (Science Research Council, Chilton (UK). Rutherford and Appleton Labs.). Jan 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702891.

Bristol - Cambridge - Geneva - Lausanne - Heidelberg - Queen Mary College - Rutherford collaboration.

The α parameter for $\Xi^- \rightarrow \Lambda\pi^-$ decay has been determined to be αsub(Ξ)-= -0.462 +- 0.015, from a sample of 1.5 x 10^5 events recorded in the CERN SPS hyperon beam. This value is 2.5 standard deviations higher than the current world average.

8545 **Quark jets from antineutrino interactions. Pt. 2. Inclusive particle spectra and multiplicities in the quark jets.** Berge, J.P.; Bogert, D.; Endorf, R.; Hanft, R.; Malko, J.A.; Nezrick, F.A.; Orava, R. (Fermi National Accelerator Lab., Batavia, IL (USA)); Ammosov, V.V.; Denisov, A.G.; Gapienko, G.S. (Institut Fiziki Vysokikh Ehnergij, Serpukhov (USSR)). *Nuclear Physics [Section] B;* **203**: No. 1, 1-15(9 Aug 1982).

We present results on inclusive particle production in the antineutrino charged current induced hadron jets observed in the Fermilab 15 ft bubble chamber. Fractional energy distributions, particle ratios and average multiplicities of the hadrons in the jets are measured. Ratios between the inclusive production rates of different mesons in the jets are studied to seek evidence for the d-quark origin of the observed hadrons. Good over-all agreement with the hypothesis of d-quark fragmentation with universal fragmentation functions obeying isospin systematics is established.

8546 Quark jets from antineutrino interactions. Pt. 3. Transverse structure of the quark jets. Berge, J.P.; Bogert, D.; Endorf, R.; Hanft, R.; Malko, J.A.; Nezrick, F.A.; Orava, R. (Fermi National Accelerator Lab., Batavia, IL (USA)); Efremenko, V.I.; Fedotov, A.V.; Gorichev, P.A. (Institut Teoreticheskoj i Ehksperimental'noj Fiziki, Moscow (USSR)). *Nuclear Physics [Section] B;* **203**: No. 1, 16-26(9 Aug 1982).

We extend our systematic study of the properties of hadron jets produced in antineutrino-nucleon charged current interactions to those observables which characterize the distribution of particles perpendicular to the jet axis. These antineutrino-induced jets are found to have properties similar to those of the jets observed in e^+e^- annihilation at comparable c.m. energies. No deviations from the simple quark-parton model predictions are found.

8547 Inclusive vector-meson production in the central region of the pp collisions at $\sqrt{s}$ = 63 GeV. Di Ciaccio, A.; Gordon, H.; Hogue, R.; Killian, T.; Ludlam, T.; Winik, M.; Woody, C. (Brookhaven National Lab., Upton, NY (USA)); Botner, O.; Burkert, V.; Fabjan, C.W. (European Organization for Nuclear Research, Geneva (Switzerland)). *Nuclear Physics [Section] B;* **203**: No. 1, 27-39(9 Aug 1982).

Production of rho^0, K*^{0}, anti K*^{0}, and PHI have been measured in proton-proton collisions at the CERN Intersecting Storage Rings (ISR) at low rhosub(T) in the central region. The transverse mass sepctra are well described by exp(-$\alpha$$\mu$sub(T)), with α = -6.4 +- 0.2 GeV^{-1}. The cross sections for dsigma/dy vertical stroke sub(y=0) are 6.5 +- 0.8 +- 1.2 mb for rho^0, 1.9 +- 0.3 +- 0.3 mb for K*^{0}, 1.9 +- 0.3 +- 0.3 mb for anti K*^{0}, and 0.60 +- 0.12 +- 0.13 mb for PHI, where the first error is statistical and the second is systematic.

8548 Search for nucleon decay: the deep underground water Cerenkov detector and the homestake tracking spectrometer. Cherry, M.L. (Dept. of Physics, Univ. of Pennsylvania, Philadelphia); Daily, T.; Lande, K.; Lee, C.K.; Marshall, E.; Steinberg, R.I.; Cleveland, B. pp 22-40 of Second workshop on grand unification. Leveille, J.P.; Sulak, L.R.; Unger, D.G. (eds.). Boston, MA; Birkhaeuser (1981). Contract AC02-81ER40012.

From 2. workshop on grand unification; Ann Arbor, MI, USA (24 Apr 1981).

We report the initial result of a search for nucleon decay using a 300-ton water Cerenkov detector located 1480 m underground in the Homestake gold mine at Lead, South Dakota. We find T/sub N/ > 2.4 x 10^{31} Bμy, where T/sub N/ is the nucleon total lifetime and where Bμ is the model-dependent probability of production and detection of a stopping and decaying muon following a nucleon decay event. In the SU(5) grand unified model, calculations of Bμ vary from approximately 5 to 10%, thereby yielding nucleon total lifetime limits ranging from 1 to 2 x 10^{30} y. We also describe our plans for a conceptually new nucleon decay detector which will permit study of this process for lifetimes up to 3 x 10^{32} y. This detector will be a completely-vetoed completely-active 1000-ton liquid scintillation tracking spectrometer also located at a depth of 1480 m in the Homestake Gold Mine. This instrument will be sensitive to all nucleon decay modes; it will have a spatial resolution of 30 cm (0.6 radiation lengths), thereby permitting identification of the decay secondaries; it will measure the total ionization energy released by the nucleon decay with a resolution of 10%, thereby permitting study of the inclusive decay mode distribution by observing the full energy peak and neutrino escape peaks; and it will measure the charge of lepton secondaries as well as the polarization of secondary muons. By virtue of its excellent energy and spatial resolution and great depth underground, the spectrometer will be remarkably free of background and ambiguity.

8549 Measurement of the semileptonic decay of charmed mesons at the electron-positron storage ring DORIS. Roemer, O. Hamburg, Germany; Deutsches Elektronen-Synchrotron (1979). 114p. (In German). (DESY-F—35-79/02).

Thesis.

The semileptonic decay of charmed mesons produced in e^+e^- reactions above 4 GeV c.m. energy was studied using the DASP detector. By the selection of events with one electron and at least two addtional charged particles (>= 1 hadron) the semileptonic decays of charmed mesons could extensively be separated from decays of the heavy lepton tau. The momentum spectrum of the electrons excludes large contributions of the purely leptonic decay D → e anti v and the Cabibbo suppressed decay D → e anti vπ, but is compatible with the decays D → e anti v K and D → e anti v Ksup(*)(892) e.g. a mixing of both. The semileptonic branching ratio of neutral and charged D mesons is by a comparison of the inclusive electron cross section to the total hadronic contributing to the production of charmed hadrons determined to Bsub(e) = (8.5 +- 2.2)%. For the mean semileptonic branching ratio of all charmed hadrons contributing to the cross section in the c.m. energy range from 3.9 GeV to 5.2 GeV Bsub(e) = (7.5 +- 2.0)% is obtained. The determination of the semileptonic branching ratio from the part of electron-hadron events with two electrons in the final state yields Bsub(e) = (13 +- 5)%. The semileptonic decay is therefore suppressed relatively to the nonleptonic decay of charmed hadrons, but the semileptonic branching ratio is larger than it is expected from an analogy to the decay of strange particles.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 8599, 8600, 8709

8550 (AD-A—114504/4) A generalized curve approach to elementary particles. Technical summary report. Young, L.C.; Nowosad, P. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Jan 1982. 17p. NTIS, PC A02/MF A01.

The theory of MRC Technical Summary Report 2067 is applied in a simplified form to a Relativistic One-Particle Universe, and boundary and symmetry conditions are imposed. The existence, for the particle, of a series of resonance states and a series of gauge states is derived. For the proton and the electron, a selection of such states account for the elementary particles observed to date.

8551 (DESY—81-064) Technicolour particles at LEP. Barbiellini, G.; Coignet, G.; Gaillard, M.K.; Girardi, G.; Sorba, P.; Ellis, J.; Nanopoulos, D.V.; Sikivie, P.; Matteuzzi, C.; Savoy-Navarro, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1981. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750367.

After an introduction into the technicolour theories the light colourless and electrically neutral pseudoscalars with masses between 350 MeV and 3 GeV are considered which might be detected at LEP via radiative toponium decays. Furthermore, the pair production of such particles in e^+e^--annihilations is discussed. Then the prospects for studying coloured pseudoscalars are considered.

8552 (DESY—81-077) Stefan-Boltzmann law at high temperature for the gluon gas. Montvay, I.; Pietarinen, E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Nov 1981. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750444.

We determine the energy density of the pure SU(3) Yang-Mills system by Monte Carlo simulation. In the high temperature regime the Stefan-Boltzmann law is satisfied within errors.

8553 (DESY—81-078) Nonforward QCD ladder diagrams. Bartels, J.; Loewe, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Nov 1981. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750445.

We extend the standard analysis of the QCD planar ladder diagrams to the nonforward direction. Results are used for calculating exclusive and semiinclusive cross sections of diffractive photoproduction in the small-x region of ep-collisions. As an example we estimate the event rate for diffractive photoproduction of the neutral vector boson at Hera energies.

8554 (DESY—82-003) Production of heavy resonances with electron and muon beams. Cleymans, J.; Kuroda, M.; Gounaris, G.J.; Koerner, J.G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750662.

The inelastic leptoproduction of heavy resonances J (J = J/psi, UPSILON, ...) is investigated in a model where γsub(v)g → Jg is assumed to be the dominant mechanism. Analytic expressions for the differential cross section as well as for the helicity amplitudes are presented. A detailed numerical analysis of the angular distribution of the muon pair arising from the decay of the heavy resonance in its rest frame is presented.

8555 (DESY—82-005) Azimuthal dependence of deep inelastic heavy resonance production. Cleymans, J.; Kuroda, M.; Gounaris, G.J.; Koerner, J.G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750668.

The dependence on the azimuthal angle between the lepton-scattering plane and the plane defined by the virtual photon and the J/psi is calculated in a photon-gluon fusion model in which the J/psi is represented by the appropriate quark wave function. Our results differ substantially from models based on canti c production below charmed particle threshold thus providing a way to distinguish phenomenologically between these two models.

8556 (DESY—82-006) Angular distribution of inclusive lepton pairs from heavy quarkonium decay. McKay, D.W.; Koerner, J.G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750669.

We calculate polar and azimuthal angular distributions of inclusive lepton pairs in the decay Qanti $Q(1^{--}) \rightarrow 1^{+}1^{-} + X$ from the first order QCD process Qanti $Q(1^{--}) \rightarrow 1^{+}1^{-} + gg$. We provide opening angle distributions of the lepton pair in order to assess the measurability of the lepton pairs.

8557 (DESY—82-029) Higher order QCD corrections for $e^{+}e^{-}$ annihilation jet cross sections. Kramer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750982.

The author gives a review about calculations of higher order QCD corrections for $e^{+}e^{-}$ annihilation cross sections.

8558 (DESY—82-033) O(αsub(s))² calculation of energy-energy correlation in $e^{+}e^{-}$ annihilation and comparison with experimental data. Barreiro, F.; Ali, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1982. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751059.

The authors calculate the angular correlation for the process $e^{+}e^{-} \rightarrow$ qanti qq using QCD perturbation theory.

8559 (DESY—82-034) Radiative decay of orthoquarkonium via two intermediate gluons: 1^{--}(Qanti Q) → γ + 1^{++}(qanti q). Koerner, J.G.; Krammer, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1982. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751060.

We investigate the decay of a heavy $^{3}S_{1}$(Qanti Q) vector meson into a real photon and two off-shell intermediate gluons which create a $^{3}P_{1}$ (qanti q) axial vector meson. As an application we suggest to look for the decay J/PSI → γ + D(1285).

8560 (DESY—82-035) Properties of gluon jets. Jones, L.M.; Migneron, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1982. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751061.

We compute the expected properties of gluon jets in a model based on the KUV jet calculus and recombination. Emphasis is placed on: a) the production of baryons, and b) the question of whether hadrons produced by the decays of Zweig rule stable quarkonia (e.g. the upsilon) in $e^{+}e^{-}$ have markedly different energy spectra from those produced by the adjacent quark-antiquark continuum.

8561 (DESY—82-036) BRS transformation and color confinement. Nishijima, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1982. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82751062.

The condition of confinement of quarks and gluons in QCD is derived. It is shown that color confinement is realized when there exist massles scalar color-octet bound states of two Faddeev-Popov ghosts.

8562 (FERMILAB-CONF—81/78-THY) Models for hadrons. Quigg, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1981. Contract AC02-76CH03000. 148p. (CONF-8108142—1). NTIS (US Sales Only). Order Number DE83002535.

From Meeting on gauge theories in high energy physics; Les Houches, France (3 Aug 1981).

Mf only; illegibility does not permit reproduction.

This series of lectures covers the following topics: quarks for SU(2); SU(3) and light quark spectroscopy; orbitally excited hadrons; some implications of QCD; quarkonium; bag model; glueballs and related topics; the idea of the 1/N expansion in QCD; and regrets. 499 references, 44 figures. (GHT)

8563 (UWThPh—1982-13) Comment on searches for excited leptons in $e^{+}e^{-}$-collisions. Pietschmann, H.; Stremnitzer, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1982. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702889.

See also B. Adeva et al. MIT Technical Report 123, January 1982.

Recently limits on mass or coupling constant on heavy excited leptons have been given by measurement of the $e^{+}e^{-}$ final states. The authors point out that these limits can be substantially improved by the fact that such excited leptons must contribute to the anomalous magnetic moments of electron and for muon.

8564 Production of protons and LAMBDA's in $e^{+}e^{-}$ jets from jet calculus and the recombination model. Migneron, R.; Jones, L.M.; Lassila, K.E. (Theory Group, Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **26**: No. 9, 2235-2256(1 Nov 1982). Contract AC03-76SF00515;W-7405-ENG-82.

We compute the expected yields of protons and LAMBDA's in $e^{+}e^{-}$ annihilation, using the Konishi-Ukawa-Veneziano jet calculus and the recombination model. Our results have many features in common with the data, including their approximate size. We derive a differential equation for baryon production, and show that the terms we have calculated are one of three physically different contributions.

8565 Detection of elastic light-by-light scattering at SLAC. Mikaelian, K.O. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Physics Letters, [Section] B;* **115**: No. 3, 267-269(2 Sep 1982).

We discuss the possibility of detecting γγ → γγ at SLAC. The experiment consists in colliding the presently available 19.5 GeV γ beam with a 4.66 eV laser light. We give the differential cross section for this set-up. We suggest beam-splitting the present laser, and discuss the advantages of frequency conversion.

8566 Non-potential interactions and the origin of masses of elementary particles. Sun, J. (Peking Univ., China). *Hadronic Journal;* **5**: No. 3, 975-1000(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

We propose a fundamental assumption on internal states of particles. It follows from the fundamental assumption that: (1) the constituents of particles become non-particle objects; and (2) there appear naturally non-potential interactions. This non-potential interaction leads to a series of interesting results, one of which is that it yields the origin of masses of elementary particles. All mass values are given by the theory without pre-assumed mass values of the constituents (except the rest mass of the electron; mass is a physical quantity which appears only in particles but not in their constituents). The theoretically calculated mass values are in excellent agreement with the experimental values. In all calculations, only one constant b = 0.99935867 is introduced (bc being the speed of internal motion).

8567 **Stochastic phase space formulation and non-potential interactions.** Ali, S.T. (Concordia Univ., Montreal, Quebec). *Hadronic Journal;* 5: No. 3, 1001-1022(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

A recently developed formulation of quantum mechanics is described, which is based on the idea of localizing particles in stochastic phase space. This approach, which even in relativistic domain, adheres strictly to the probability interpretation of quantum mechanics, is shown to bypass all the conventional problems of relativistic quantum mechanics - such as the theory not admitting a conserved probability current or being unstable against small perturbations. Our formalism generates a quantization procedure which is applicable both to relativistic and non-relativistic systems, however, the interactions involved automatically become non-local and non-potential in nature. The theory is applied to quantize a classical model of a spin-1/2 charged particle in an external electromagnetic field. The energy levels for such a system are studied and the entire hydrogen spectrum including Lamb shift effects are shown to be reproduced. Implications of the theory for the short-distance structure of space-time are discussed.

8568 **Non-Euclidean and non-Desarguesian geometries for non-selfadjoint systems.** Schober, A. (Inst. for Basic Research, Cambridge, MA). *Hadronic Journal;* 5: No. 3, 1140-1183(Apr 1982). (CONF-820136—). Contract AC02-80ER10651.

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

In a recent paper we studied the construction of geometries which have different characteristics in the exterior and interior of a hadron, e.g., are conventional in the exterior case, but generalized in the interior one. In this paper we continue this study under the more specific condition that a hadron is a closed non-selfadjoint system, that is, it verifies the general conservation laws of total quantities, but the internal forces are of non-potential type. We begin our study with the indication that non-Desarguesian geometries apply to open non-selfadjoint systems, such as particles under a combination of a constant gravitational field and resistive forces. We then pass to the problem of structure of a hadron by pointing out that the departures from conventional relativity settings in the interior strong problem indicated by recent experiments suggest that the right geometry for a hadron could have a suitable combination of non-Euclidean and non-Desarguesian characters. All possible models of non-Euclidean geometries are exhibited first. We then pass to the identification of as many non-Desarguesian planes as made possible by available axiomatic, algebraic and group theoretical approaches. The construction of a geometry which is non-Euclidean (e.g., Galilean or Minkowskian) in the exterior problem, and non-Desarguesian in the interior case is then discussed. We provide a geometric interpretation of the recent discovery of the violation of the time-reversal symmetry announced at our Conference by Slobodrian and Conzett, as well as the violation of the SU(2)-spin symmetry indicated by Rauch's experiments. In fact, our geometries can recover these symmetries for the trajectory of the center of mass of a hadron, while the symmetries are violated in the interior strong problem.

8569 **Introduction to the Lie-admissible treatment of non-potential interactions in Newtonian, statistical, and particle mechanics.** Santilli, R.M. (Inst. for Basic Research, Cambridge, MA). *Hadronic Journal;* 5: No. 2, 264-359(Feb 1982). (CONF-820136—). Contract AC02-80ER10651.

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Views on the experimental origin, theoretical formulation, and mathematical structure of nonpotential interactions in Newtonian, statistical, and particle mechanics are presented. The simplest but most dominant consideration of this introduction is the expectation that the charge distribution of hadrons is not perfectly rigid, but admits deformations under suitable impacts with other hadrons. These rather natural deformations then imply: (1) the breaking of the SU(2)-spin symmetry for the interior strong problem, with the understanding that conventional, conserved, total spin quantities are recovered in the exterior treatment; (2) the consequential necessary breaking of the T- and P-symmetries, also for the interior strong problem, owing to the explicit dependence of the discrete operators on spin, with the understanding that the center-of-mass trajectories of closed strong systems recover the T- and P-symmetries; and (3) the origin of irreversibility at the most elemental level of nature, via the nonpotential interactions originating from mutual penetrations and overlappings of hadrons under strong interactions.

8570 **Experimental, theoretical, and mathematical elements for a possible Lie-admissible generalization of the notion of particle under strong interactions.** Santilli, R.M. (Inst. for Basic Research, Cambridge, MA). *Hadronic Journal;* 4: No. 4, 1166-1257(Jun 1981). (CONF-8008162—). Contract AC02-80ER10651.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

A primary objective of the research is the achievement of clear experimental knowledge on the intrinsic characteristics of particles (such as magnetic moment, spin, space parity, etc.) under strong interactions. These characteristics, when known, have been measured a number of times, but all times for particles under long range electromagnetic interactions (e.g., for bubble chamber techniques). The same characteristics are then generally assumed to persist under the different physical conditions of the strong interactions, while no direct or otherwise final measurement under strong interactions exists at this time. The advocated physical knowledge is clearly important for controlled fusion, as well as for a serious study of the foundations of strong interactions. The paper initiates the study by considering the following alternatives. A: the electromagnetic characteristics of particles persist in the transition to the strong; or B: variations in these characteristics are physically conceivable, mathematically treatable, and experimentally detectable. The need to conduct additional experiments, and achieve a final resolution of the issue, is stressed throughout the paper. In the hope of contributing toward this future goal, the paper then reviews the quantitative treatment of possible deviations via the Lie-admissible generalization of Lie's theory, with particular reference to the Lie-admissible generalizations of Lie group, Lie algebras, and enveloping associative algebras. A generalized notion of extended particle under nonlocal nonpotential strong interactions emerge from these studies. The theory is applied to the re-elaboration of the data on the spinor symmetry via neutron interferometers. It is shown that the data are indeed consistent with a breaking of the SU(2)-spin symmetry due to nonlocal nonpotential forces. A number of experiments for the future resolution of the issue are indicated.

8571 **Search for light charged scalar bosons.** Kim, D.Y.; Naqvi, S.I.H. (Univ. of Regina, Saskatchewan). *Hadronic Journal;* 4: No. 4, 1306-1317(Jun 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Neutrino induced weak production process anti nu N $\rightarrow$ Ne^+ phi$^-$ is suggested for the signature of the existence of a low mass charged scalar boson, PHION. The experimental set up is that of the modified Reines et al. experiment on elastic anti nu e scattering. We estimate a counting rate in the proposed experiment of approximately 12/day. The background from the competing inverse beta process anti nu p $\rightarrow$ ne^+ is a factor of two to three smaller. We

also show that the recent Reines et al.'s measured ratio of 0.43 of the missing reactor neutrinos can be explained in terms of the PHION production model proposed in this paper.

8572 **Generalization of Heisenberg uncertainty principle for strong interactions.** Santilli, R.M. (Inst. for Basic Research, Cambridge, MA). *Hadronic Journal;* **4**: No. 3, 642-657(Apr 1981). (CONF-8008162—). Contract AC02-80ER10651.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

We propose a unified form of possible generalizations of Heisenberg uncertainty principle for strong interactions, which is based on the product of the envelope of the dynamical equations representing wave packets under conditions of mutual overlapping and nonlocal non-Hamiltonian forces. For conventional associative products of operators, we recover the conventional Heisenberg relations for particles under long range electromagnetic interactions and no appreciable wave overlapping. For nonassociative Lie-admissible products of operators we have (a) a number of generalizations of Heisenberg's equations of increasing algebraic complexity; (b) the capability of representing a correspondingly progressive increase of conditions of wave overlapping and nonlocal, non-Hamiltonian forces; and (c) a corresponding, rather inevitable sequence of generalizations of Heisenberg uncertainty relations. All these possibilities are expressed in a unified way by postulating generalized uncertainty relations whereby the product of operators is that of the envelope of the dynamical equations. For conditions of minimal wave overlapping under strong interactions, such as in the nuclear structure, we expect a very small nonlocal non-Hamiltonian component of the force and a minimal departure from Heisenberg principle. For progressive increase of wave overlappings, such as in the structure of hadrons, or in the structure of stars undergoing gravitational collapse, we expect a corresponding progressive replacement of Heisenberg principle with more general principles. The problem of the experimental resolution of the exact or only approximate validity of Heisenberg principle under strong interactions is considered for a more detailed treatment in a separate paper.

8573 **Structure model of the elementary charge.** Santilli, R.M. (Inst. for Basic Research, Cambridge, MA). *Hadronic Journal;* **4**: No. 3, 770-784(Apr 1981). (CONF-8008162—). Contract AC02-80ER10651.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

I formulate the hypothesis that the electrostatic interaction between two electrons, two positrons, or one electron and one positron is explicitly dependent on time according to a pulsating behavior with period $T = 0.829 \times 10^{-20}$ sec. The hypothesis is motivated by the need to bypass a number of technical difficulties for a deeper understanding of the process $e^+ + e^- \rightarrow 2\gamma$, such as the fact that current relativistic treatments, including retarted and advanced potentials, of one electron and one positron at rest with respect to each other and at small mutual distances produce a null total electromagnetic field, while the total field of two photons is not null. An initial treatment of the hypothesis is presented at the level of the time-dependent perturbation theory. It is shown that, upon selection of a suitable functional form, the time dependence is ignorable for periods of time large compared to 10^{-20} sec, as well as for the electrostatic interactions of one electron with a cluster of elementary charges (e.g., a proton). A generalization of the Coulomb law is thus achieved in such a way as to reproduce the conventional law either for large values of time or for large collections of elementary charges. The generalization is based on a structure model of the electron charge, in the sense that the charge emerges as derived, via time averages, from structure data of the electron. A generalization of Rutherford's cross section is also identified in which, again, the departures from the conventional form become ignorable for large values of time or for large collections of elementary charges. The possibilities for experimental tests of the prediction of the paper are briefly indicated via the use of (a) resonance effects; (b) more accurate measurements of cross sections; and (c) suitable refinements of the experimental information on the positronium.

8574 **SU(3)-subsector approach to hadron properties and the classification problem.** Mignani, R. (Universita Degli Studi Di Roma, Italy). *Hadronic Journal;* **4**: No. 3, 785-823(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

I review the essential features and main applications of the SU(3)-subsector approach to hadron properties, developed in the last two years by Dattoli, Prosperi, Camiz, and myself. Such a formalism is based on the three-quark sectors of SU(N), which are obtained by picking out three of the N quarks in all possible ways. The sectors can be divided in four classes, according to the charges of the quarks constituting them, and an SU(3) algebra can be defined for any class of sectors, by introducing generalized operators (like hypercharge and isospin) induced by the SU(N) generators. General formulae are derived for baryon magnetic moments, both in the case of an exact symmetry and of a partially broken one. Mass sum rules for hadrons are discussed by means of a generalized Gell-Mann-Okubo mass formula. Lastly, it is stressed that the effectiveness of the formalism is better understood if one looks on SU(N) as a classification group for hadrons, rather than concerning hadron structure. In this connection, a till open legacy of Heisenberg about quark hypothesis is singled out.

8575 **Particles with gauge degrees of freedom.** Sniatycki, J. (Univ. of Calgary, Alberta). *Hadronic Journal;* **4**: No. 3, 844-878(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Canonical dynamics of particles with internal degrees of freedom is analyzed. Geometric quantization of relativistic charged particles and particles with isotopic spin degrees of freedom is discussed.

6453 Particle Invariance Principles And Symmetries

8576 **Tests of time symmetry: evidence of violation of time reversal invariance.** Slobodrian, R.J. (Laval Univ., Quebec City, Quebec). *Hadronic Journal;* **5**: No. 3, 679-713(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Time symmetry is unquestionably violated in macroscopic physical phenomena, and thus there is a unidirectional evolution of our universe. At the submicroscopic level, nuclear and elementary particles were believed to interact conserving time symmetry to a high degree. Recent experiments, dealing with polarizations and analyzing powers in nuclear reactions, have produced evidence of finite effects indicating a breakdown of time symmetry. These experiments, the underlying formalism, and the implications concerning basic assumptions are discussed. Spin dependent effects and their observables, like polarizations and analyzing powers, are very sensitive to small changes in the reaction amplitudes, hence they constitute ideal tools for tests of time symmetry.

8577 **Concerning tests of time-reversal invariance via the polarization-analyzing power equality.** Conzett, H.E. (Lawrence Berkeley Lab., CA). *Hadronic Journal;* **5**: No. 3, 714-728(Apr 1982). (CONF-820136—). Contract W-7405-ENG-48.

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Previous tests of time-reversal invariance via comparisons of polarizations and analyzing powers in nuclear scattering have been examined. It is found that all of these comparisons fail as adequate tests of time-reversal invariance either because of a lack of experimental precision or the lack of sensitivity to any time-reversal symmetry violation.

8578 **Short-range interactions and irreversibility in statistical mechanics.** Tellez-Arenas, A. (Orleans Univ., France). *Hadronic Journal;* **5**: No. 3, 733-749(Apr 1982). (In French). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The text of this paper corresponds to the talk given at the First International Conference on Non-potential Interactions and their Lie-admissible Treatment under the heading Short-range Interactions and T-symmetry breaking in Statistical Mechanics. The aim of this talk was to show that the idea of overlapping associated with short-range interactions allows one very simply to introduce irreversibility into the reversible laws of evolution deduced from Hamiltonian mechanics and in a way that shows itself finally to be correct. In order to do this we adopted the principle which is the basis of the work of this Conference. This is that, although the description of a set of interacting particles by local potential theories is justified when these particles may be considered as points, i.e., when only long-range interactions occur, it is no longer possible to ignore the finite size and mutual overlap of the particles when short-range interactions take place, and in this latter case a description involving non-local non-potential terms is required. Thus, on one hand, we recall that when a variation is observed in the individual state of a body in short-range interaction, the notion of overlapping expresses itself by the existence of a non-arbitrary small time interval, and, on the other hand, we show that this finite time interval brings out a non-locality in time that breaks the reversibility. Starting from the first equation in the reversible BBGKY sequence, we obtained in this way a new, irreversible equation, which seems to be well adapted to the description of evolution phenomena in Statistical Mechanics since it reduces to the Boltzmann Equation when the general conditions of validity of the latter are satisfied.

8579 **Tests of time and iso-spin symmetries: violation of time reversal invariance.** Slobodrian, R.J. (Laval Univ., Quebec City, Quebec). *Hadronic Journal;* **4**: No. 4, 1258-1279(Jun 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

The comparison of the polarization of a reaction product having non-zero spin with the asymmetry of the cross section (analyzing power) for the inverse reaction initiated by a polarized beam, is a test of time symmetry of nuclear reactions, i.e., time reversal invariance. Some recent results indicate a violation. A review of the subject is presented with particular stress on nucleon transfer reactions.

8580 **Demonstration of SU(2)-symmetry by neutron interferometry.** Rauch, H.; Zeilinger, A. (Atominstitut der Oesterreichischen Universitaeten, Vienna). *Hadronic Journal;* **4**: No. 4, 1280-1294(Jun 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Neutron interferometry provides a direct test of the 4π-symmetry of a fermion wave function. The experiments performed with perfect crystal interferometers to demonstrate that SU(2)-symmetry property are reviewed. The measured periodicity value of 716.8 +- 3.8 degrees, which is the most precise one obtained up to now, is in good agreement with theoretical prediction. Effects are discussed which may give rise to deviations of the experimental result from the 4π value. Furthermore, an account of epistemological aspects is given relating to the question of the operational applicability of the term rotation in the interpretation of the experiments. Finally, proposals for new, more precise, experiments are made. Some of these experiments may have particular relevance in the context of considerations of a breaking of SU(2) symmetry under strong interaction.

6454 Field Theory

REFER ALSO TO CITATION(S) 8479, 8575, 8719, 8742, 8749, 8764, 8766, 8767, 8768, 8769, 8772

8581 **(BONN-HE—82-5) Symmetry and fermion degeneracy on a lattice.** Raszillier, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Mar 1982. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750684.

In this paper we consider the general form of finite difference approximation to the Dirac (Weyl) Hamiltonian on a lattice and investigate systematically the dependence on symmetry of the number of particles described by it. Our result is, that to a symmetry - expressed by a crystallographic space group - there corresponds a minimal number of particles, which are associated to prescribed points of momentum space (the unit cell of the reciprocal lattice). For convenience of the reader we show, using the existing detailed descriptions of space groups, how these results look for all the relevant (symmorphic) symmetry groups. Only for lattice Hamiltonians with a momentum dependent mass term can this degeneracy be reduced and even eliminated without reducing the symmetry.

8582 **(DESY—81-067) Monopoles, vortices, and confinement.** Mack, G.; Pietarinen, E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750368.

An exact relation is established between an SO(3) lattice gauge theory model without monopoles, and a corresponding SU(2) model. Elimination of the monopoles (and their strings) leads to a substantial lowering of the entropy of thin vortices and a corresponding decrease of the string tension for low γ. This is revealed by approximate calculations of the vortex free energy and is confirmed by Monte Carlo data. The value of the physical transition temperature to 'hot gluon soup' is also lowered considerably.

8583 **(DESY—81-068) Some topics in quantum field theory.** Symanzik, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1981. 6p. (CONF-8108126—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750369.

From 6. international conference on mathematical physics; Berlin, F.R. Germany (11 Aug 1981).

After a few general remarks on lattice theory, I describe the relation of lattice to continuum theory on the basis of perturbation theory, and deduce herefrom the principles of constructing 'improved' lattice actions. Then I briefly describe some recent perturbative and nonperturbative results in continuum theory. Finally, I point out a few recent approaches of more speculative nature that appear to merit particular attention. In the appendix, a few standard formulae from renormalization group analysis are collected for reference.

8584 **(DESY—82-012) Four families of composite quarks and leptons.** Albright, C.H.; Schrempp, B.; Schrempp, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750717.

Four families of composite quarks and leptons, two standard and two non-standard, are found in a unique solution SU(3)sub(H)sub(C) x SU(6)sub(R) of a restricted 't Hooft anomaly-matching program. Testable predictions emerge, such as prohibition of $\mu \to e\gamma$, zero charge asymmetry in $e^+e^- \to tau^+ tau^-$ in contrast to $e^+e^- \to \mu^+\mu^-$, and a rich new hadron spectrum with masses around Msub(W). A minimal set of spectator fermions contains color-singlet objects with fractional quark-like charges.

8585 **(DESY—82-028) Numerical studies of phase transitions in Su(N)/Zsub(N) lattice gauge theories.** Drouffe, J.M.; Moriarty, K.J.M.; Muenster, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750983.

The average action per plaquette is calculated for the pure SU(N)Zsub(N), N = 2,3,4,5 and 6 gauge groups using strong coupling expansions up to 13th order for Euclidean lattice gauge theory in four space-time dimensions. These expansions are compared with Monte Carlo generated data and agreement is found to be less than 1% for $0 <= \beta <= \beta$sub(c), where βsub(c) is the critical inverse temperature for the appropriate gauge group considered.

8586 **(DESY—82-031) Dirac-Kaehler equation and fermions on the lattice.** Becher, P.; Joos, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1982. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82751052.

The geometrical description of spinor fields by E. Kaehler is used to formulate a consistent lattice approximation of fermions. The relation to free simple Dirac fields as well as to Susskind's description of lattice fermions is clarified. The first steps towards a quantized interacting theory are given. The correspondence between the calculus of differential forms and concepts of algebraic topology is shown to be a useful method for a completely analogous treatment of the problems in the continuum and on the lattice.

8587 **(DOE/ER/40008—27) Research in theoretical elementary-particle physics. Progress report, March 1, 1981-February 28, 1983.** Field, R.D.; Ramond, P.M.; Thorn, C.B. (Florida Univ., Gainesville (USA)). 1982. Contract AS05-81ER40008. 18p. NTIS, PC A02/MF A01. Order Number DE83003207.

The first two years of operation of the Theoretical Particle Physics group at the University of Florida are discussed. At present our group consists of three full professors, one assistant professor, one DOE Outstanding Junior Instructor, three post-docs and one graduate student. The group has been very productive during the first two years of its existence resulting in the publication of over 30 papers covering a broad range of topics in theoretical high energy physics. In addition, members of our group have traveled and given important talks at national and international physics conferences. The research we have accomplished in such subjects as quantum field theory, quantum chromodynamics, and grand unified theories has increased mankind's understanding of elementary particle physics. It is the intention of our group to continue to actively participate in the further development of high energy physics.

8588 (Juel-Spez—146, pp 99-100) **Quantization of TDHF-fields.** Reinhardt, H.; Reinhard, P.G.; Goeke, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8589 **Light singlet particles and their cosmological consequences in Witten-type supersymmetric models.** Hung, P.Q. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Suzuki, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Physics). *Physics Letters,* [*Section*] *B;* **115**: No. 3, 207-211(2 Sep 1982).

In a class of supersymmetric gauge models which generate a large mass scale from a supersymmetry breaking mass scale M through loop corrections, there exists generally a very light scalar particle which transforms like a singlet under SU(3)sub(c) X SU(2)sub(L) with no U(1) charge. Cosmological constraints on such a particle are so severe that an upper bound is set on possible values of supersymmetry breaking scale in this class of models as M approx. $<=$ 500 TeV provided that the large mass scale is 10^{15} GeV and the mass of the light scalar particle is generated in one-loop order. This bound holds even if the goldstino is not absorbed into the gravitino.

8590 **Double epsilon-expansion for planar models with two phase transitions.** Kenway, R.D. (Los Alamos National Lab., NM (USA). Theoretical Div.). *Nuclear Physics* [*Section*] *B;* **210**: No. 1, 29-49(30 Aug 1982).

The two-dimensional planar model in the presence of either constant or random symmetry-breaking fields, which locally select p preferred directions, undergoes two phase transitions for certain values of p. A systematic renormalization of the sine-Gordon field theory describing these systems is carried out using a double expansion in the deviation from the upper critical temperature and in the temperature difference between the two transitions. A complete description is obtained of the phase diagram for threefold symmetric random field.

8591 **Monte Carlo studies of SU(N)/Zsub(N) lattice gauge theories in four dimensions.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)); Moriarty, K.J.M. (Royal Holloway Coll., Englefield Green (UK). Dept. of Mathematics). *Nuclear Physics* [*Section*] *B;* **210**: No. 1, 50-58(30 Aug 1982).

Using Monte Carlo techniques on a four-dimensional spacetime lattice, we study SU(N)/Zsub(N) gauge theories for N = 3, 4, 5 and 6. We find first-order phase transition at critical inverse temperatures of βsub(c) = 6.40, 12.0, 19.5 and 32.0 for $SU(3)/Z_3$, $SU(4)/Z_4$, $SU(5)/Z_5$ and $SU(6)/Z_6$, respectively.

8592 **Monte Carlo studies of Wilson loops in four-dimensional U(2) gauge theory.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)); Moriarty, K.J.M. (Royal Holloway Coll., Englefield Green (UK). Dept. of Mathematics). *Nuclear Physics* [*Section*] *B;* **210**: No. 1, 59-68(30 Aug 1982).

Wilson loops are calculated using Monte Carlo simulations for pure U(2) gauge theory on a 6^4 lattice. The loops appear to contain an area law piece in both the high and low temperature regions. The string tension is discontinuous at $\beta=\beta$sub(c), where βsub(c) is the critical inverse temperature. This suggests that the first-order phase transition in U(2) gauge theory is not a deconfining phase transition. The determinant of the Wilson loop, however, extracts the U(1) part of the theory and appears to lose the area at low temperature.

8593 **Potential and restoration of rotational symmetry in SU(2) lattice gauge theory.** Lang, C.B. (European Organization for Nuclear Research, Geneva (Switzerland)); Rebbi, C. (Brookhaven National Lab., Upton, NY (USA)). *Physics Letters,* [*Section*] *B;* **115**: No. 2, 137-142(26 Aug 1982).

We study by numerical techniques the restoration of rotational invariance in SU(2) lattice gauge theory. Results on the potential between two static sources in the fundamental representation are also represented.

8594 **1/N topological expansion for lattice QCD.** Chen, T.; Tan, C.I. (Brown Univ., Providence, RI). *Physics Letters* [*Section*] *B;* **108**: No. 2, 127-130(14 Jan 1982). Contract AC02-76ER03130.

A U(N/sub c/) gauge theory with a global U(N/sub f/) flavor symmetry is investigated in the limit both N/sub c/ and N/sub f/ large with the ratio zeta exactly equal to N/sub f//N/sub c/ fixed.

8595 **How well can a phenomenological quark-quark interaction approximate QCD?.** Rohrlich, F. (Syracuse Univ., NY). *Hadronic Journal;* **4**: No. 3, 831-843(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

On a fundamental level this question is at least in part a special case of the more general question: how well can a quantum field theoretical interaction be approximated by a direct interaction between particles (i.e., without explicit use of the intermediate boson field)? The present state of the theory needed for an answer to this question is reviewed and the reasons for the necessity of many-body forces and of velocity-dependent interactions are indicated. A classical relativistic Hamiltonian theory of direct interactions for a finite number of particles has recently been developed. The requirement of a cluster decomposition which has caused considerable difficulties seem to have been resolved. The outstanding remaining problem is a consistent quantum mechanical formulation of this theory First steps toward this goal are presently in progress.

8596 **Problems in the quantization of quadratic Hamiltonians.** Broadbridge, P. (Univ. of Adelaide, Australia). *Hadronic Journal;* **4**: No. 3, 899-948(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Adherents to the Lie-admissible formulation of strongly interacting systems are interested in the possible non-locality of the

strong field, and in the need of an algebraic covering of canonical quantization. From a general field theory with non-localized action, linearization via the introduction of supplementary conditions produces a model which may be analyzed in terms of independent subsystems with finite degrees of freedom and general quadratic Hamiltonian. This paper is largely devoted to a review of the quantization of arbitrary quadratic Hamiltonians. This subject has had a long history, but problems still remain. A system with general quadratic Hamiltonian can either be reduced to a collection of independent harmonic oscillators, or (a) the classical system possesses an unstable equilibrium point; and (b) canonical quantization in the Heisenberg picture leads to mode operators whose formal mode space, unlike the Fock space for Boson annihilation operators cannot have a positive definite inner product; and (c) the Segal approach to construction of a vacuum representation of the C.C.R. is inapplicable; and (d) closely associated with the quadratic Hamiltonian H(q,p) is a system of Bosons with quadratic Hamiltonians H'(a,a/sup f/) which cannot be reduced by a Gogoliubov transformation to a system of free quasi-particles; and (e) from well-known examples, the Hamiltonian will not have a discrete semi-bounded spectrum in the Schroedinger representation. In this paper, a formal presentation is avoided, except on those occasional instances where applicable reference sources are not known to the author. Missing details can be retrieved from the listed references, which make contact with the vast subject area outlined above.

8597 **Clifford, Dirac, and Majorana algebras, and their representations.** Salingaros, N. (Univ. of Crete, Greece). *Hadronic Journal;* 4: No. 3, 949-980(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

We show that the Dirac algebra is an algebra in five dimensions. It has traditionally been confused with the two distinct algebras in four dimensions, which we have identified as the Majorana algebra and the Clifford algebra in Minkowski space-time. A careful discussion of the subtle inter-relationship between these three algebras is achieved by employing a basis of differential forms. In addition, we provide for the first time a 4 x 4 complex matrix representation of the Clifford algebra in Minkowski spacetime, and compare it to the matrix representations of the Dirac and Majorana algebras. A remark on Eddington's E-numbers is included.

8598 **Towards a structure theory for Lie-admissible algebras.** Wene, G.P. (Univ. of Texas, San Antonio). *Hadronic Journal;* 4: No. 2, 580-607(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

The concepts of radical and decomposition of algebras are presented. Following a discussion of the theory for associative algebras, examples are presented that illuminate the difficulties encountered in choosing a structure theory for nonassociative algebras. Suitable restrictions, based upon observed phenomenon, are given that reduce the class of Lie-admissible algebras to a manageable size. The concepts developed in the first part of the paper are then reexamined in the context of this smaller class of Lie-admissible algebras.

8599 **Second workshop on grand unification.** Leveille, J.P.; Sulak, L.R.; Unger, D.G. (eds.). Boston, MA; Birkhaeuser (1981). 328p. (CONF-810485—). Harrison M. Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109.

From 2. workshop on grand unification; Ann Arbor, MI, USA (24 Apr 1981).

Separate abstracts were prepared for 22 of the 25 papers from this workshop. Three papers were previously included in the data base. (KAW)

8600 **Neutrino-free universe.** Glashow, S.L. (Massachusetts Inst. of Tech., Cambridge). pp 1-10 of Second workshop on grand unification. Leveille, J.P.; Sulak, L.R.; Unger, D.G. (eds.). Boston, MA; Birkhaeuser (1981). Contract AC02-76ER03069.

From 2. workshop on grand unification; Ann Arbor, MI, USA (24 Apr 1981).

Aspects of neutrino mass are discussed. Evidence for neutrino mass in oscillations; beta decay, neutrinoless double beta decay and gravitational effects is described. The B-L symmetries of models of the neutrino mass are reviewed and the relationship of neutrino mass to stellar evolution and cosmology is considered. (KAW)

8601 **Effective Lagrangian and effective parameters in grand unified theories.** Yao, Y.P. (Univ. of Michigan, Ann Arbor). pp 163-178 of Second workshop on grand unification. Leveille, J.P.; Sulak, L.R.; Unger, D.G. (eds.). Boston, MA; Birkhaeuser (1981).

From 2. workshop on grand unification; Ann Arbor, MI, USA (24 Apr 1981).

Let us accept the premise of universality in a unification scheme, which is supposed to occur at extremely high energy. Naturally one wonders whether one can obtain a low energy effective theory to describe the more common physical processes. In mathematics, let the grand unification Lagrangian be L(phi), in which some of the fields describe heavy particles, phi/sub heavy/, while the others describe light particles, phi/sub light/. Let us suppose that the energy of reaction is way below the thresholds of producing heavy particles. The question is whether we can reduce L(phi) to L/sub eff/ (phi/sub light/, which can be used to construct all the relevant matrix elements. It seems that an answer can be readily given, because the generating functional is e/sup iW/ = integral d phi e/sup i integral d^4x (L + J phi)/, in which J is the source function, the variation of which can produce an external phi.

6455 Scattering Theory

REFER ALSO TO CITATION(S) 8734, 8752

65 PHYSICS RESEARCH

8602 **(IKF—41) Annual report 1981.** Bethge, K.; Steuer, E. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). 1982. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83780036.

Separate intries were prepared for each of the research program summaries included.

8603 **(Juel-Spez—146) Annual report 1981.** Gruemmer, F.; Mayer-Boericke, C.; Schult, O. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Mar 1982. 168p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE83780035.

Separate intries have been prepared for each of the project summaries included.

6510 Nuclear Physics

8604 **(INIS-SU—116) Nuclear electronics. Volume. 12. Theory and electronic equipment of physical experiment.** Agakhanyan, T.M. (ed.). (Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya SSSR, Moscow; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1980. 106p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE83780060.

Abstracts of individual items from Volume 12 were prepared separately for the data base. (GHT)

8605 **(Juel—1755) Summary of neutron scattering lengths.** Koester, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Dec 1981. 132p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750702.

All available neutron-nuclei scattering lengths are collected together with their error bars in a uniform way. Bound scattering lengths are given for the elements, the isotopes, and the various spin-states. They are discussed in the sense of their use as basic parameters for many investigations in the field of nuclear and solid state physics. The data bank is available on magnetic tape, too.

Recommended values and a map of these data serve for an uncomplicated use of these quantities.

8606 **(KFK—3127) Report about the results of activities in research and development 1980 of the Institut fuer Angewandte Kernphysik.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1). Feb 1981. 37p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750429.

Progress is reported in the following research areas of the institute: structure and dynamics of solids, electronic structure of solids and magnetism, physical foundations and applications of a spallation neutron source, ion implantation and channeling, development and improvement of neutron spectroscopic methods and application in material science, nuclear physics, linear accelerator for the spallation neutron source, safeguards, nuclear data measurements, applications of nuclear methods in medicine and engineering.

8607 **(KFK—3304) Final report on research and development work in 1981 of the Institut fuer Kernphysik.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Feb 1982. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750703.

A review is given about the work done at the named Institute. It concerns measurements with the CELLO detector at the e^+e^- storage ring PETRA, nuclear physics with fast neutrons, experiments with stopped antiprotons, muonic atoms, intermediate energy proton and pion reactions, the development of radiation detectors, HF-superconductivity, the spallation neutron source, and inertial confinement. A list of publications is added.

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 8576, 8579, 8579

8608 **(BONN-HE—82-3) Further reduction of three-body problem with finite-range forces.** Kharchenko, V.F.; Kuzmichev, V.E. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Feb 1982. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750664.

The well-known approach to the consideration of two-body problem in the nuclear physics, based on the use of a parameter characterizing the finite size of the interaction range, is extended to the case of the three-body problem. It is shown in the general case, without any approximation, that the problem of three particles interacting with arbitrary pair finite-range potentials is reduced to the solution of the one-dimensional set of integral equations for functions depending on the spectator variable. The kernels of the obtained equations are determined by the two-particle scattering wave function off the energy shell in the pair interaction range and in turn satisfy the auxiliary two-variable integral equations with the integration over the finite range of the three-particle configuration space. The auxiliary set of equations has nonsingular kernels and can be solved by simple methods. In zero approximation, taking only the pair correlation of particles into account, the kernel of the basic set is known in the explicit form, in the zero-range force limit it turns into the Skornyakov-Ter-Martirosyan's kernel. On the basis of the performed reduction a new approach to solution of the three-body problem is proposed. Some examples with the simplest model interactions are given. With the use of the experimental data on the binding energy of Σ^--hyperdeuteron the binding energy of the three-particle Σ-hypernucleus, consisting of two neutrons and one Σ^--hyperon (Σ^--hypertriton) is calculated.

8609 **(KFK—3235) Measurement of the vector analyzing power it_{11} in the elastic pion-deuteron scattering in the region of the (3,3)resonance.** Proebstle, G.F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1981. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750446.

Thesis.

The vector analyzing power it_{11} was measured for several angles at 142 MeV and 256 MeV by scattering positive pions elastically from a polarized deuteron target. The polarization of the deuteron was done by the method of dynamic nuclear polarization. The scattered pions were detected in a high resolution magnetic spectrometer. At large angles the recoil deuterons were identified to suppress the background. The experimental results are quite different for the two energies measured. At 142 MeV, the angular distribution has a smooth behaviour while at 256 MeV a strong oscillatory pattern was observed. The comparison of the data with theoretical predictions leads to the following conclusions: At 142 MeV the data are well described by sophisticated Faddeev-calculations. The inclusion of pion absorption does not produce better agreement. The predictions of the Glauber Approximation agree with the measurements only at forward angles. In all theories, the small non-resonant partial waves in the πN-channel must be included. At 256 MeV no conventional theory (Glauber Approximation, D^+-model, Betz-Lee-model, Faddeev-calculation) is able to reproduce the data. The only, and quite good agreement with the data is obtained, if at least one dibaryon-resonance is included in the calculation.

6513 Nuclear Properties And Reactions, A=6-19

REFER ALSO TO CITATION(S) 8576, 8577, 8579, 8579

8610 (Juel-Spez—146, pp 23-24) **Investigation of the (p,^{3}He) reaction on ^{13}C, ^{15}N and ^{16}O at Esub(p) = 45 MeV.** Rapp, V.; Staudt, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8611 (Juel-Spez—146, pp 27-28) **Microscopic model calculation for (p,α) reactions on light nuclei.** Hauser, H.J.; Hoyler, F.; Staudt, G.; Oberhummer, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8612 (Juel-Spez—146, pp 31-32) **Continuous charged particle spectra from ^{40}Ca + ^{6}Li reactions at an incident energy of 26 MeV/nucleon.** Rebel, H.; Gils, H.J.; Planeta, R.; Buschmann, J.; Neumann, B.; Klewe-Nebenius, H.; Zagromski, S.; Shyam, R.; Machner, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8613 (Juel-Spez—146, pp 100-101) **Quantized ATDHF calculations for ^{8}Be.** Reinhard, P.G.; Gruemmer, F.; Goeke, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8614 **Excitation of analog isovector giant resonances via the (n, p) reaction on ^{14}N and ^{16}O at 60 MeV.** Needham, G.A.; Brady, F.B.; Fitzgerald, D.H.; Romero, J.L.; Ullmann, J.L.; Watson, J.W.; Zanelli, C. (California Univ., Davis (USA)); King, N.S.P. (Los Alamos Scientific Lab., NM (USA)); Satchler, G.R. (Oak Ridge National Lab., TN (USA)). *Nuclear Physics [Section] A;* **385**: No. 3, 349-372(13 Sep 1982).

Data were accumulated for the (n,p) reaction on ^{14}N and ^{16}O using 60 MeV neutrons. Angular distributions of the cross sections for eight proton groups were extracted and compared to distorted-waves Born approximation (DWBA) calculations using a simple macroscopic model. Enhancements in the spectra were seen in each case in the region of excitation corresponding to the giant dipole resonance (GDR) of the target nucleus. DWBA calculations show that these excitations are primarily dipole and favor the use of the Goldhaber-Teller form factor. Comparison with photo-absorption measurements suggests that there may also be significant contributions to the (n,p) reaction from 'spin-flip' dipole excitations. The other proton groups could be correlated with the results of other experiments and include excitations of analogs of the giant isovector 'magnetic' dipole mode of ^{14}N.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 8681

8615 (Juel-Spez—146, pp 7-8) **High energy proton stripping by ^{27}Al and ^{28}Si nuclei: ground state transitions.** Djaloeis, A.; Gopal, S.; Bojowald, J.; Mayer-Boericke, C.; Oelert, W.; Puttaswamy, N.G.; Turek, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8616 (Juel-Spez—146, pp 11-12) **Alpha-transfer-reaction study in the middle of the sd-shell.** Oelert, W.; Berg, G.P.A.; Djaloeis, A.; Mayer-Boericke, C.; Turek, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8617 (Juel-Spez—146, pp 13-15) **Breakup of ^{3}He-projectile at Esub(in) = 130 MeV.** Bojowald, J.; Djaloeis, A.; Gopal, S.; Mayer-Boericke, C.; Oelert, W.; Puttaswamy, N.G.; Turek, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8618 (Juel-Spez—146, pp 24-25) **Analysis of the reaction ^{20}Ne(p,α)^{17}F.** Rohwer, T.; Oelert, W. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8619 (Juel-Spez—146, pp 25-27) **DWBA analysis of the (p,α) reactions on ^{26}Mg and ^{27}Al.** Hoyler, F.; Staudt, G.; Martin, S.A.; Oelert, W. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8620 (Juel-Spez—146, pp 32) **Light charged particle emission from ^{197}Au + ^{20}Ne.** Bohlen, H.J.; Fuchs, G.; Machner, H.; Riepe, G.; Protic, D. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8621 (Juel-Spez—146, pp 40) **Elastic scattering of 50 MeV π^- on ^{32,36}S for the determination of radii differences of the neutron distribution.** Barnett, B.; Gyles, B.; Johnson, R.R.; Lolos, G.; Blackmore, E.W.; Erdmann, K.L.; Gill, D.R.; Kraushaar, J.; Masterson, T.; Wiedner, C.A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8622 (Juel-Spez—146, pp 43-44) **Identification and decay of ^{36}P.** Hill, J.C.; Koch, H.R.; Shizuma, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8623 **Analog giant dipole excitation in Si(n,p) at 59.6 MeV.** Ullmann, J.L.; Brady, F.P.; Fitzgerald, D.H.; Needham, G.A.; Romero, J.L.; Castaneda, C.M. (California Univ., Davis (USA). Dept. of Physics; California Univ., Davis (USA). Crocker Nuclear Lab.); King, N.S.P. (Los Alamos National Lab., NM (USA)). *Nuclear Physics* [*Section*] *A;* **386**: No. 1, 179-188(20 Sep 1982).

The parent analog of the giant dipole resonance in ^{28}Si is studied by means of the (n,p) reaction. The continuum contribution to the giant dipole region was estimated by a phenomenological parameterization. The observed cross section exhausts 31% of the SJ sum rule; 88% of the GT sum rule or 67% of the Myers-Swiatecki prediction. A comparison is made to the giant resonance region observed in the ^{28}Si(p,p') reaction which was recently used, via comparison to ^{28}Si(α,α'), to infer that the GDR in ^{28}Si is not excited or at least not seen in (p,p').

8624 **Beta decays of ^{25}Na, ^{25}Al and ^{29}Al.** Alburger, D.E.; Warburton, E.K. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics* [*Section*] *A;* **385**: No. 3, 474-482(13 Sep 1982).

The radioactivities ^{25}Na, ^{25}Al, and ^{29}Al were produced in the ^{22}Na(t,p)^{25}Na, ^{24}Mg(d,n)^{25}Al, and ^{27}Al(t,p)^{29}Al reactions using a 3.5 MV Van de Graaff. γ-radiations were measured by means of a target-transfer system and a Ge(Li) detector with or without Compton suppression. Decay schemes derived for ^{25}Na and ^{29}Al are in general agreement with earlier results, but with improved accuracy of branching ratios and much sharper limits on the intensities of certain unobserved β- and γ-ray transitions. Precision measurements of the energies of principal γ-rays gave results in keV for the listed decaying bodies as follows: ^{25}Na - 1611.716(11); ^{25}Al - 1611.708(11); and ^{29}Al - 1273.361(9). The energy determinations of the ^{25}Mg 1612 keV γ-transition measured in the decay of ^{25}Na and ^{25}Al differ by 8 +- 9 eV.

8625 **Elastic and inelastic scattering of 79.5 MeV ^{11}B and 87.5 MeV ^{10}B ions.** Fulmer, C.B.; Mukhopadhyay, S.; Satchler, G.R.; Auble, R.L.; Ball, J.B.; Bertrand, F.E.; Gross, E.E.; Hensley, D.C. (Oak Ridge National Lab., TN (USA)). *Nuclear Physics* [*Section*] *A;* **385**: No. 1, 83-108(30 Aug 1982).

The elastic scattering of 79.5 MeV ^{11}B ions has been studied for seven targets ranging in mass from ^{24}Mg to ^{197}Au and of 87.5 MeV ^{10}B ions for three of these targets (sup(24,25)Mg, ^{60}Ni). Angular distributions were measured from approx. equal to 10^0 c.m. in steps of 0.5^0, to angles beyond 40^0 c.m. where the elastic cross sections are approx. <= 10^{-3} of the Rutherford values (except for ^{197}Au). Inelastic data for exciting the lowest 2$^+$ states of sup(24,26)Mg and ^{60}Ni were also obtained. Important odd-A-even-A differences are observed in the ^{11}B elastic angular distributions for the Mg and Al targets; for ^{10}B scattering these are obscured by projectile quadrupole moment effects on the elastic scattering. The elastic data were analyzed using the optical model with potentials of both Woods-Saxon and double-folding form. The data for both ^{10}B and ^{11}B are consistent with the potential obtained in the folding model with the M3Y interaction without renormalization. The inelastic data were analyzed by the distorted-waves method.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 7943, 8612, 8670

8626 (Juel-Spez—146, pp 1) **Strong 1$^+$ excitation in ^{48}Ca(p,p') scattering at Esub(p) = 44.4 MeV.** Gaul, G.; Santo, R.; Sondermann, G.; Katayama, I.; Styczen, B.; Berg, G.P.A.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8627 (Juel-Spez—146, pp 4) **Search for 1$^+$ states in ^{58}Ni(p,p') scattering.** Gaul, G.; Santo, R.; Sondermann, G.; Katayama, I.; Styczen, B.; Berg, G.P.A.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8628 (Juel-Spez—146, pp 9-10) **(d,^{3}He) reaction on iron isotopes.** Glaudemans, P.W.M.; Metsch, B.C.; Heyde, K.; Isacker, P. van; Waroquier, M.; Wenes, G.; Lopac, V.; Paar, V.; Puttaswamy, N.G.; Djaloeis, A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8629 (Juel-Spez—146, pp 19-20) **Experimental evidence for asymmetric excitation of nuclei.** Bechstedt, U.; Machner, H.; Budzanowski, A.; Jahn, P.; Mayer-Boericke, C. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8630 (Juel-Spez—146, pp 20-21) **Fireball analysis of ^{54}Fe(α,α'x) reactions at 120 MeV.** Machner, H.; Bechstedt, U.; Djaloeis, A.; Jahn, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8631 (Juel-Spez—146, pp 28-29) **Light particle coincidences in α-induced reactions.** Ludewigt, B.; Gaul, G.; Glasow, R.; Santo, R.; Loehner, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8632 (Juel-Spez—146, pp 30) **Measurement and theoretical predictions of integral excitation functions for α-induced reactions on Ti, V and Mn.** Michel, R.; Brinkmann, G.; Galas, M.; Stueck, R. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8633 (Juel-Spez—146, pp 76-77) **Fragmentation of the M1-strength in ^{58}Ni and ^{60}Ni.** McGrory, J.B.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8634 (Juel-Spez—146, pp 77-78) **Effect of the Δ(1232)-isobar in ^{48}Ca(p,n)-cross sections.** Osterfeld, F.; Krewald, S.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8635 **Comparison of πi and π^- elastic and inelastic scattering off ^{52}Cr at 180 MeV.** Lunke, C.; Egger, J.P.; Goetz, F.; Gretillat, P.; Schwarz, E. (Neuchatel Univ. (Switzerland). Inst. de Physique); Perrin, C. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires); Preedom, B.M. (South Carolina Univ., Columbia (USA)); Mischke, R.E. (Los Alamos Scientific Lab., NM (USA)). *Journal of Physics G: Nuclear Physics;* 7: No. 7, 895-902(Jul 1981).
Angular distributions for π^+ and π^- elastic and inelastic scattering from ^{52}Cr at an incident pion energy of 180 MeV are presented. The percentage difference of inelastic cross sections to the 2_1^+ state is shown to be -19+-8% indicating a proton deformation length larger than the neutron deformation length for this level.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 8617, 8625, 8633, 8670

8636 **(GKSS—82/E/8) Measurements of neutron activation cross-sections at 14.4 MeV for ^{68}Zn and ^{90}Zr.** Barreira Filho, J.L.; Fanger, H.U. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750960.
Activation cross-sections at (14.4 +- 0.3) MeV neutron energy have been measured by means of conventional and cyclic activation techniques, utilizing an intense neutron generator (KORONA) at GKSS-Forschungszentrum Geesthacht. The reactions investigated and the corresponding cross-sections [in mb] are ^{68}Zn(n,p)sup(68g)Cu [5.0 +- 1.1]; ^{68}Zn(n,p)sup(68m)Cu [3.6 +- 0.6]; ^{68}Zn(n,α)^{65}Ni [10.3 +- 1.8]; ^{90}Zr(n,p)sup(90m)Y [9.8 +- 1.7]; ^{90}Zr(n,α)sup(87m)Sr [3.2 +- 0.5] and ^{90}Zr(n,2n)sup(89m)Zr [75 +- 12]. For comparison with the results of this work, the hitherto known cross-section data from the literature were compiled, too, in this paper.

8637 (IKF—41, pp 3-6) **Neutron and gamma emission at the fusion reactions ^{86}Kr + ^{64}Ni and ^{86}Kr + ^{76}Ge.** Dittmar, H.; Arlt, U.; Bass, R.; Sapotta, K.; Stelzer, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8638 **(Juel-Spez—145) Gamma- and conversion-electron data from slow neutron capture in ^{74}Se, ^{75}Se, ^{76}Se and ^{77}Se and from ^{75}Se(E.C.)^{75}As.** Tokunaga, Y.; Boerner, H.G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Mar 1982. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82751043.
In this report we give complete sets of γ-lines seen in the reactions ^{74}Se(n,γ) and ^{76}Se(n,γ), and the γ-lines observed in the ^{75}Se(n,γ) and ^{77}Se(n,γ) reactions and from the ^{75}Se(E.C.)^{75}As decay. Further for strong low-energy transitions in the ^{74}Se(n,γ) and ^{76}Se(n,γ) reactions, the conversion electron data are shown.

8639 (Juel-Spez—146, pp 10) **Study of the ^{62}Ni(d,^{3}He)^{61}Co reaction.** Marinov, A.; Katayama, I.; Berg, G.; Huerlimann, W.; Martin, S.A.; Mayer-Boericke, C.; Meissburger, J.; Oelert, W.; Roemer, J.G.M.; Rogge, M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8640 (Juel-Spez—146, pp 44-45) **Study of low spin states in ^{75,77}Se populated in slow neutron capture.** Boerner, H.G.; Barreau, G.; Schreckenbach, K.; Faust, H.; Brissot, R.; Hofmeyer, C.; Weinreich, R.; Tokunaga, Y.; Seyfarth, H.; Schult, O.W.B. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 8617, 8636

8641 **(GSI—81-11) Properties of atomic nuclei at the boundary of proton instability, discussed at the example of very neutron deficient isotopes in the mass range 100-150.** Roeckl, E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1981. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750370.
In this paper it shall be tried to strike the balance after the first years of experimenting at the on-line mass separator of the GSI Darmstadt and to present the main results of the study of very neutron deficient isotopes in the mass range 90-150 as well as the resulting questions for further experiments. First some foundations concerning the properties of neutron deficient nuclei and the measuring method are explained. The results and their interpretation are discussed using examples for the alpha decay, the beta decay, the mass-energy-area, and the proton-drip line. Finally the obtained results are summarized, and an outlook to further studies of nuclear properties far from beta stability is given.

8642 (IKF—41, pp 9-11) **Determination of multipole mixing parameters in ^{93}Mo, ^{96}Mo, ^{95}Ru, and ^{97}Ru.** Mehler, G.; Blumenstein, G.; Weniger, R.; Stelzer, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8643 (Juel-Spez—146, pp 2-3) **Proton scattering on ^{102}Pd and ^{110}Pd at Esub(p) = 45 MeV using the magnetic spectrograph BIG KARL.** Fretwurst, E.; Lindstroem, G.; Reden, K.F. von; Berg, G.P.A.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Oelert, W.; Riech, V.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8644 (Juel-Spez—146, pp 4-5) **Nuclear spectroscopy of ^{108}Ag using the (p,d)-transfer reaction in comparison to neutron capture investigations.** Katayama, I.; Styczen, B.; Berg, G.P.A.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Roemer, J.G.M.; Seyfarth, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8645 (Juel-Spez—146, pp 6) **Investigation of core-coupled multiplets in ^{143}Nd by ^{148}Nd(p,t) reaction.** Wrzesinski, J.; Wesselborg, C.; Zell, K.O.; Bazzacco, D.; Brentano, P. von; Moore, C.F.; Katayama, I.; Styczen, B.; Berg, G.P.A.; Huerlimann, W. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8646 (Juel-Spez—146, pp 46) **Rotational band in ^{99}Y.** Monnand, E.; Pinston, J.A.; Schussler, F.; Battistuzzi, G.; Lawin, H.; Shizuma, K.; Sistemich, K.; Pfeiffer, B. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8647 (Juel-Spez—146, pp 47) **Half-life of the 469 keV state in ^{99}Nb.** Battistuzzi, G.; Kawade, K.; Lawin, H.; Shizuma, K.; Sistemich, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8648 (Juel-Spez—146, pp 48) **Decay of ^{102}Y to levels of ^{102}Zr.** Shaanan, M.; Shizuma, K.; Hill, J.C.; Lawin, H.; Selic, H.A.; Sistemich, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8649 (Juel-Spez—146, pp 49) **^{107}Ag(n,γ)^{108}Ag reaction.** Mitsunari, T.; Mac Mahon, T.D.; Schreckenbach, K.; Kane, W.R.; Kondurov, I.A.; Sushkov, P.; Loginov, Y.; Bogdanovic, M.; Seyfarth, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8650 (Juel-Spez—146, pp 50) **Level scheme of ^{110}Ag from the (n,γ) reaction.** Sushkov, P.; Kondurov, I.A.; Bogdanovic, M.; Mitsunari, T.; Mac Mahon, T.D.; Breitig, D.; Baader, H.A.; Koch, H.R.; Seyfarth, H.; Schult, O.W.B. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8651 (Juel-Spez—146, pp 51) **High spin level structure of ^{133}La.** Morek, T.; Beuscher, H.; Bochev, B.; Haenni, D.R.; Kutsarova, T.; Lieder, R.M.; Mueller-Veggian, M.; Neskakis, A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8652 (Juel-Spez—146, pp 52-53) **Structure of high spin states in ^{134}Ce.** Mueller-Veggian, M.; Beuscher, H.; Haenni, D.R.; Lieder, R.M.; Neskakis, A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8653 (Juel-Spez—146, pp 53-54) **Structure of the heavy Ce-isotopes.** Gill, R.L.; Chrien, R.E.; Shmid, M.; Gowdy, G.M.; Liou, H.I.; Chu, Y.Y.; Casten, R.F.; Warner, D.D.; Stelts, M.L.; Brenner, D.S. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8654 (Juel-Spez—146, pp 56-58) **N = 82 Gap in ^{146}Gd from β-decay studies of Tb isotopes.** Styczen, J.; Kleinheinz, P.; Piiparinen, M.; Blomqvist, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8655 (Juel-Spez—146, pp 58-60) **Two-phonon octupole excitation in ^{147}Gd.** Blomqvist, J.; Kortelahti, M.; Kleinheinz, P.; Styczen, J.; Piiparinen, M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8656 (Juel-Spez—146, pp 88-89) **Preliminary calculations for ^{146}Gd.** Conci, C.; Klemt, V. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8657 **(LA-UR—82-3466) Future prospects in n-nuclear interactions.** Moss, J.M. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 11p. (CONF-821050—2). NTIS, PC A02/MF A01. Order Number DE83003549.
From Cyclotron facility workshop; Bloomington, IN, USA (27 Oct 1982).
Portions of document are illegible.
I examine in detail two research areas, polarization observables and antiproton-nucleus reactions, which should have near-term future impact on our understanding of the interaction of medium-energy nucleons in nuclei. More speculative future experiments employing cooled beams, double spectrometer systems, and large Q-valure low momentum-transfer reactions are also discussed.

6518 Nuclear Properties And Reactions, A=150-189

8658 (IKF—41, pp 12-13) **Measurement of the quadrupole moment of ^{176}Lu.** Gerl, J.; Elze, T.W.; Venkata Ramaniah, K.; Ronge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8659 (Juel-Spez—146, pp 36-37) **Non-equilibrium particle emission in 45 MeV α particle bombardment of ^{159}Tb.** Didelez, J.P.; Morek, T.; Bochev, B.; Lieder, R.M.; Kutsarova, T.; Neskakis, A.; Mueller-Veggian, M.; Mayer-Boericke, C. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8660 (Juel-Spez—146, pp 37-38) **Study of non equilibrium particle emission from the ^{159}Tb(α,charged particle xnγ) reaction at Esub(α) = 75 MeV.** Didelez, J.P.; Morek, T.; Kutsarova, T.; Bochev, B.; Lieder, R.M.; Neskakis, A.; Mueller-Veggian, M.; Mayer-Boericke, C. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8661 (Juel-Spez—146, pp 38-39) **Emission of nonequilibrium particles in the bombardment of ^{159}Tb with 110 MeV α particles and the validity of the PEP model.** Didelez, J.P.; Morek, T.; Bochev, B.; Lieder, R.M.; Kutsarova, T.; Neskakis, A.; Mueller-Veggian, M.; Protic, D.; Riepe, G.; Mayer-Boericke, C. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8662 (Juel-Spez—146, pp 55) **45 ns high-spin isomer in the doubly odd ^{150}Eu nucleus.** Soramel, F.; Styczen, J.; Ercan, A.; Prokofjev, P.; Kleinheinz, P. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8663 (Juel-Spez—146, pp 61-62) **Study of side bands in ^{189}Os.** Sletten, G.; Neskakis, A.; Lieder, R.M.; Beuscher, H.; Bochev, B.; Haenni, D.R.; Mueller-Veggian, M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8664 (Juel-Spez—146, pp 62-63) **Interpretation of side bands in ^{189}Os in the framework of the cranked shell model.** Sletten, G.; Neskakis, A.; Lieder, R.M.; Beuscher, H.; Bochev, B.; Haenni, D.R.; Mueller-Veggian, M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8665 (Juel-Spez—146, pp 63-64) **Blocking effects in side bands of ^{183}Os.** Sletten, G.; Borggreen, J.; Pedersen, J.; Lieder, R.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8666 (Juel-Spez—146, pp 65-67) **Negative-parity side bands in ^{183}Os.** Sletten, G.; Borggreen, J.; Pedersen, J.; Lieder, R.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8667 (Juel-Spez—146, pp 67) **High-spin states in ^{188}Au.** Keskakis, A.; Lieder, R.M.; Beuscher, H.; Bochev, B.; Kutsarova, T.; Haenni, D.; Morek, T.; Mueller-Veggian, M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8668 (Juel-Spez—146, pp 68) **Curved crystal study of de-excitation gamma rays in ^{184}W following neutron capture.** Davidson, W.F.; Reich, C.W.; Greenwood, R.C.; Koch, H.R. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8669 **Time-dependent Hartree-Fock study of angular momentum transfer in 6 and 12 MeV/A heavy ion reactions of ^{86}Kr on ^{166}Er.** Cusson, R.Y.; Maruhn, J.A. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Oak Ridge National Lab., TN (USA)); Stoecker, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Michigan State Univ., East Lansing (USA). Dept. of Physics and Astronomy). *Nuclear Physics* [*Section*] *A;* 385: No. 1, 76-82(30 Aug 1982).
Three-dimensional TDHF calculations are performed for ^{86}Kr + ^{166}Er at 6 and 12.2 MeV/A from which we obtain Wilczynski plots and angular momentum loss curves versus incoming angular momentum. These compare well with recent experimental data from GSI and are consistent with the observed fast projectile fission at 12.2 MeV/A. Finite cross sections for capture as nuclear molecules are predicted.

6519 Nuclear Properties And Reactions, A=190-219

REFER ALSO TO CITATION(S) 8617, 8620, 8625

8670 (IKF—41, pp 1-2) **Mass and charge transfer at the reactions ^{208}Pb + ^{58}Ni and ^{208}Pb + ^{64}Ni.** Bass, R.; Hartmann, V.; Noll, H.; Sapotta, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8671 (IKF—41, pp 13-14) **Gamma-gamma angular correlation measurements at the nuclei ^{192}Pt and ^{194}Pt for the determination of multipole mixing ratios.** Mauthofer, A.; Stelzer, K.; Weniger, R. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8672 (Juel-Spez—146, pp 11) **Investigation of proton-particle proton-hole multiplets in ^{208}Pb.** Katayama, I.; Mairle, G.; Schindler, K.; Schmidt-Rohr, U.; Styczen, B.; Berg, G.P.A.; Huerlimann, W.; Martin, S.A.; Meissburger, J.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8673 (Juel-Spez—146, pp 16) **Small angle α scattering experiments.** Morsch, H.P.; Rogge, M.; Turek, P.; Decowski, P.; Zemlo, L.; Martin, S.A.; Berg, G.P.A.; Katayama, I.; Meissburger, J.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8674 (Juel-Spez—146, pp 29) **α-emitter yields from α-induced reactions on ^{206,208}Pb and ^{209}Bi.** Ernst, J.; Friedland, W.; Kolev, D.; Scholz, W.; Suhr, S.; Berg, G.P.A.; Huerlimann, W.; Katayama, I.; Martin, S.A.; Roemer, J.G.M. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8675 (Juel-Spez—146, pp 33-34) **Study of pre-equilibrium emission following the bombardment of nuclei with 200 MeV protons.** Didelez, J.P.; Frascaria, N.; Gerlic, E.; Hourani, E.; Morlet, H.; Machner, H.; Protic, D.; Riepe, G. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8676 (Juel-Spez—146, pp 34-35) **Interpretation of proton spectra measured in the ^{209}Bi(α,pxn) reaction by the exciton model.** Didelez, J.P.; Lieder, R.M.; Bochev, B.; Kutsarova, T.; Machner, H.; Mueller-Veggian, M.; Neskakis, A.; Mayer-Boericke, C. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8677 (Juel-Spez—146, pp 80-81) **Pionic $\Delta l = 1$ charge exchange modes in heavy mass nuclei.** Osterfeld, F.; Krewald, S.; Dermawan, H.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8678 (Juel-Spez—146, pp 82) **Spin polarization in the ground state of ^{207}Pb.** Wambach, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8679 (Juel-Spez—146, pp 82-83) **Two-particle two-hole damping of 'giant 1^+-states' in ^{208}Pb.** Wambach, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8680 **(TRI-PP—81-14) Elastic scattering of 400 MeV Protons by ^{208}Pb.** Hutcheon, D.A.; Cameron, J.M.; Liljestrand, R.P. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Apr 1981. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702897.
Cross-section and analyzing power angular distributions for elastic scattering of 400 MeV protons by ^{208}Pb have been measured between 3° and 51°. Results have been compared to second-order KMT calcuations of the optical potential. There is evidence that free nucleon-nucleon scattering amplitudes do not adequately describe nucleon propagation in nuclear matter at this energy.

6520 Nuclear Properties And Reactions, A=220 And Above

8681 (IKF—41, pp 15-16) **Coulomb excitation of actinide nuclei by ^{32}S projectiles.** Bohn, H.; Faestermann, T.; Gerl, J.; Elze, T.W.; Ower, H.; Pfennig, J.; Ronge, K. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8682 **(JAERI-M—9601) Evaluation of neutron nuclear data for ^{243}Cm.** Nakagawa, Tsuneo; Igarashi, Sin-iti. (Japan Atomic Energy Research Inst., Tokyo). Jul 1981. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82702895.
The neutron nuclear data of ^{243}Cm were evaluated in the neutron energy region from 10^{-5} eV to 20 MeV. The evaluated quantities are resonance parameters up to 26 eV, the total, fission, capture, elastic and inelastic scattering, (n, 2n), (n, 3n) and (n, 4n) reaction cross sections, angular distributions of emitted neutrons and the number of neutrons per fission. The measured data are very scarce. The evaluation was made mainly on the basis of the optical and statistical model calculations. The present results are compiled in the ENDF/B format, and they will be stored in the second version of Japanese Evaluated Nuclear Data Library, JENDL-2.

8683 (Juel-Spez—146, pp 17-18) **Fission decay of isoscalar giant resonances excited in 172 MeV α scattering from ^{238}U.** David, P.; Debrus, J.; Janssen, H.; Schulze, J.; Morsch, H.P.; Rogge, M.; Suekoesd, C.; Machner, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8684 (Juel-Spez—146, pp 86) **Electric giant resonances in ^{238}U.** Zawischa, D.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8685 **Chemical signatures for superheavy elementary particles.** Cahn, R.N. (Lawrence Berkeley Lab., CA); Glashow, S.L. *Science (Washington, D.C.);* **213**: No. 4508, 607-611(7 Aug 1981). Contract W-7405-ENG-48.

Models of unified fundamental interactions suggest the existence of many particles in the mass range 10 x 10^9 to 100 x 10^{12} electron volts. Among these may be charged particles, X^{+-}, that are stable or nearly so. The X^+'s would form superheavy hydrogen, while the X^-'s would bind to nuclei. Chemical isolation of naturally occuring technetium, promethium, actinium, protactinium, neptunium, or americium would indicate the presence of superheavy particles in the forms RuX^-, SmX^-, $^{232}ThX^-$, /sup 235,236,238/ UX^-, $^{244}PuX^-$, or $^{247}CmX^-$. Other substances worth searching for include superheavy elements with the chemical properties of boron, fluorine, manganese, beryllium, scandium, vanadium, lithium, neon, and thallium.

8686 **Absolute measurement of ν for Cf252.** Smith, J.R.; Gehrke, R.J.; Reeder, S.D. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **35**: 549(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

8687 **Estimation of the uncertainties in the ENDF/B-V Uranium 235 fission spectrum.** Maerker, R.E.; Marable, J.H.; Wagschal, J.J. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **35**: 555-556(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 8731, 8734

8688 **(AERE-TP—920) Differential cross sections for high-energy electron capture in the impulse approximation.** Briggs, J.S.; Kocbach, L.; Greenland, P.T. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Mar 1982. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702892.

The main features of the differential cross-section for electron capture in the first Born, second Born and impulse approximation have been studied. The use of peaking approximations allows simple analytic forms for the differential cross-sections to be given. The corresponding approximate cross-sections have been compared to the exact numerical cross-sections in the case of both the second Born and impulse approximations. The effect of simultaneous scattering of the incident ion by both the captured electron and the target nucleus has been investigated in the eikonal approximation. In the case of the second Born approximation at high incident velocity a closed form for the differential cross-section has been obtained.

8689 **(BONN-HE—82-8) Separable pole expansions in four-nucleon bound state calculations.** Sofianos, S.A.; Fiedeldey, H.; Haberzettl, H.; Sandhas, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Apr 1982. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750954.

We compare the utility of the Generalized Unitary Pole Expansion (GUPE) and the Energy-Dependent Pole Expansion (EDPE) for the three-body subsystem amplitudes in four-body state calculations for a variety of separable and local nucleon-nucleon interactions. It is found that, with the EDPE, the four-body binding energy is well reproduced with only two terms each for the (2+2)- and the (3+1)-subsystem, respectively, while the GUPE requires three terms for the (3+1)-channel and four terms for the (2+2)-channel. We thus conclude that pole dominance is of greater importance for the GUPE than for EDPE, which works equally well for both types of subsystems. It is found that both methods, in particular the EDPE, converge more rapidly with increasing repulsion in the two-body interaction, i.e. the more realistic the interaction becomes. Both expansions require similar computing times for a converged calculation and are about 15-20 times faster than the widely used Hilbert-Schmidt Expansion (HSE). The respective merits of the two pole expansions are discussed and compared with the HSE.

8690 **(CERN-TH—3261) Sum rule approach to the nuclear response in the isovector spin channel.** Alberico, W.M.; Ericson, M.; Molinari, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 11 Mar 1982. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702893.

We study the global features of the response of infinite nuclear matter in the spin-isospin channel through the energy weighted sum rules S_1 and $S_{sub}(-)_1$. In particular we compare the outcome of the ring approximation with the exact RPA evaluation of the sum rules. We also investigate the influence of the collective character of the response, induced by the particle hole force for a longitudinal and transverse spin couplings. We show that S_1 is insensitive to the collectivity of the response, as long as the Δ degree of freedom is ignored. The inverse energy weighted sum rule on the other hand, which is linked to the paramagnetic susceptibility, always reflects the hardening or softening of the nuclear response, due to the repulsive or attractive character of the p-h force. This quantity is well suited to the comparison with the experiments, which we perform for ^{12}C and ^{56}Fe.

8691 **(IKF—41, pp 17-21) Nucleus-nucleus collisions in the GeV/nucl. range.** Baumgardt, H.G.; Friedlaender, E.M.; Schopper, E. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8692 **(JINR-R—4-81-788) Diagrammatic representation of a one-phonon propagator in the quasiparticle-phonon nuclear model.** Kyrchev, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702894.

16 refs.; submitted to the journal Theor. Math. Phys.

A diagram technique for the quasiparticle-phonon nuclear model is proposed. Inclusion of the one- and two-phonon components only in the wave functions of the excited states of even-even deformed nuclei is shown to be equivalent to a summation of a certain class of one-loop diagrams. The contribution of the two-loop graph has been calculated. Furthermore, by closing the chain of the equations for the Green functions, the approximations, leading to the summation of the above mentioned class of diagrams have been explicitly stated.

8693 (Juel-Spez—146, pp 21-22) **Time scales in pre-equilibrium model formulations.** Machner, H. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8694 (Juel-Spez—146, pp 72-73) **Higher compression modes.** Haro, R. de; Krewald, S.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8695 (Juel-Spez—146, pp 73-74) **Isospin projection and sum rules for high multipolarity giant resonances.** Haro, R. de; Krewald, S.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8696 (Juel-Spez—146, pp 75) **Role of the Δ_{33}-resonance in low-energy nuclear physics.** Suzuki, T.; Speth, J.; Krewald, S. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8697 (Juel-Spez—146, pp 76) **Experimental signatures of the Δ_{33}-hole quenching mechanism in pionic states.** Suzuki, T.; Krewald, S.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8698 (Juel-Spez—146, pp 79) **Electron scattering coincidence experiments to study higher multipole resonances.** Co, G.; Krewald, S.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8699 (Juel-Spez—146, pp 79-80) **Meson exchange current effects in heavy nuclei.** Dehesa, J.S.; Donnelly, T.W.; Krewald, S. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8700 (Juel-Spez—146, pp 83) **Quasiparticle effective masses in finite nuclei.** Wambach, J.; Mishra, V.; Chu-Hsia, L. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8701 (Juel-Spez—146, pp 84) **Spin-isospin sum rules based on the quark model.** Brown, G.E.; Fiebig, H.R.; Wambach, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8702 (Juel-Spez—146, pp 85) **Charge-exchange resonances in deformed nuclei.** Zawischa, D.; Speth, J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8703 (Juel-Spez—146, pp 87) **MONSTER - a code for the microscopic description of deformed even-even nuclei.** Schmid, K.W.; Gruemmer, F. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8704 (Juel-Spez—146, pp 89-90) **New method to treat even- and odd-particle nuclei consistently in the framework of Landau-Migdal's theory.** Klemt, V. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8705 (Juel-Spez—146, pp 90-91) **Necessity of generalizing RPA equations to include retardation effects.** Klemt, V. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8706 (Juel-Spez—146, pp 92) **Investigation of finite range effects in (d,t) and (d,^{3}He) reactions.** Shyam, R.; Nagarajan, M.A. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8707 (Juel-Spez—146, pp 95-96) **Coulomb-dissociation at relativistic and non-relativistic energies.** Baur, G.; Hoffmann, B. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8708 (Juel-Spez—146, pp 97) **Comparison of concepts: ATDHF and functional integrals.** Reinhard, P.G.; Reinhardt, H.; Goeke, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8709 **(LBL—15175) Nuclear collisions from AMeV to ATeV: from nuclear to quark matter.** Gyulassy, M. (Lawrence Berkeley Lab., CA (USA)). Oct 1982. Contract AC03-76SF00098. 11p. (CONF-820979—2). NTIS, PC A02/MF A01. Order Number DE83003666.
From International conference on nucleus-nucleus collisions; East Lansing, MI, USA (27 Sep 1982).
The maximum energy density achieved in nuclear collisions is estimated in this energy range. Stopping power and longitudinal growth are discussed. We show that for lab energies > 100 AGeV energy densities high enough to produce a plasma can be reached. Cosmic-ray data support these calculations and suggest a possible novel signature of the plasma phase transition.

8710 **Mean effect in nuclei.** Tellez-Arenas, A. (Orleans Univ., France). *Hadronic Journal;* **4**: No. 3, 754-769(Apr 1981). (CONF-8008162—).
From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).
This paper is in two parts. In the first we recall that, in the methods used in nuclear physics to introduce a mean potential in the description of the nucleus, there remains a considerable residual interaction whose treatment by a perturbation method poses certain problems. In the second, we will show that it is possible, by a statistical method, to describe a system of potentially-interacting bodies by a set of independent quasi-particles moving in a mean field, without any residual interaction; this mean field generally contains a non-potentially-derivable term.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 7516, 7516, 7517, 7959, 8752, 8770

8711 **(AD-A—114469/0) Stimulated Cerenkov radiation produced by 100 MeV electrons. Master's thesis.** Brown, L.J. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1981. 55p. NTIS, PC A04/MF A01.
It is proposed that electromagnetic radiation of a specified frequency can be produced by stimulated Crenkov radiation in a dielectric resonator excited by a relativistic electron beam. The frequency generated depends upon the energy of the electrons and the refractive index and dimensions of the dielectric. This work describes the continuation of an experiment designed to verify the proposed radiation using 100 MeV electrons and a polyethylene slab. Problems encountered during the experiment are discussed and suggestions for continuing work are provided. Radiation is produced at several discrete frequencies, which are harmonics of the electron bunch frequency as produced by the LINAC. The absence of modes at the resonant frequency of the dielectric is understandable, considering the short length of the resonator. When the limitations imposed by the physical dimensions of the dielectric slab are considered, the results support the prediction.

8712 (Juel-Spez—146, pp 136) **Radiation protection.** Probst, H.J. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.
In Annual report 1981.

8713 **(RRC—46) Sensitivity analysis and its applications.** Sundararaman, V. (Reactor Research Centre, Kalpakkam (India)). 1981. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83900656.
Cross-section sensitivity analysis, the procedure by which one determines how sensitive a calculated result is to input cross section data, is finding increasing application in the areas of radiation shielding, reactor physics and fusion reactor blanket studies. This report presents a brief discussion of the sensitivity function and the method used for its calculation. The basis for the method is generalized perturbation theory using flux solutions to the transport equation and its adjoint. Some of the varied applications of cross section sensitivity analysis are described. Shielding benchmark experiments and the cross-section adjustment are also dealt with in detail. Advantages and disadvantages of such analysis are also described.

8714 **Transport in an air-over-ground environment of prompt neutrons and gammas from the Hiroshima and Nagasaki weapons.** Pace, J.V. III; Knight, J.R.; Bartine, D.E. (Oak Ridge National Lab., TN). pp 131-158 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

Much of the work on radiation shielding in the last two decades has been aimed at developing adequate data on transport methods and cross sections to describe the numerous prompt-neutron and the prompt and secondary gamma-ray interactions through the various materials. When adequate experimental data are available, the calculational results can be benchmarked. In the absence of such test data, however, one must rely on results obtained from the particle-transport calculations. The two most accurate methods for these calculations are the discrete-ordinates S/sub n/ method and the Monte Carlo method. This paper is concerned with the application of the S/sub n/ method for approximating a solution to the Boltzmann transport equation in an air-over-ground two-dimensional, cylindrical geometry as applied to the Hiroshima and Nagasaki environments.

8715 **Delayed radiation at Hiroshima and Nagasaki.** Scott, W.H. (Science Applications, Inc., La Jolla, CA). pp 159-178 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

The delayed gamma-ray radiation from the decay of fission products in the fireball accounts for 40 to 60% of the total gamma-ray dose at Hiroshima and Nagasaki. Research funded by the Defense Nuclear Agency updated the NUIDEA computer model of nuclear effects so that the factors that govern the delayed dose were modeled from first principles. Good comparison between this model and the variety of time-dependent measurements at different ranges, yields, and heights of burst give confidence in NUIDEA and allow its use to establish the dose-vs-range relationship for delayed gamma rays at Hiroshima and Nagasaki. Noticeable differences, however, do exist between the measurements and the model at the largest ranges and for times between 0.1 and 1.5 sec when NUIDEA predicts a lower dose rate. An uncertainty study of possible causes indicates that the low-density fireball will delay the capture of thermal neutrons in the vicinity of the fireball. At longer ranges these late, high-energy air-capture gamma rays increase the gamma-ray dose rate as seen in the measurements. This effect is not at present modeled so that, at ranges of 2 km or larger, it is difficult to separate the measured air-capture gamma-ray dose from the delayed gamma-ray dose. Although further study will be required for verification, this extra dose appears to be normally included in the discrete ordinates transport (DOT) calculation of free-in-air secondary gamma rays. The best present estimate of total gamma-ray dose is obtained by adding the initial gamma rays calculated with the DOT code to the delayed dose from the NUIDEA model.

8716 **Building-transmission factors.** Woolson, W.A. (Science Applications, Inc., La Jolla, CA); Marcum, J.; Scott, W.H.; Staggs, V.E. pp 179-200 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

Parametric representations (called the nine-parameter formula) of the measurements of the radiation transmission through Japanese house models at the BREN reactor and ^{60}Co experiments are used to correct the free-in-air (FIA) T65 dose values for buildings shielding in the built-up residential areas at Hiroshima and Nagasaki. The accuracy of transmission factors derived from the nine-parameter formula impact the accuracy of the final-exposure dose estimates in the same manner as the accuracy of weapon yield and FIA radiation transport. A preliminary investigation of the accuracy of these transmission factors, sponsored by the Defense Nuclear Agency, has focused primarily on the adequacy of the Bare Reactor Experiment, Nevada (BREN) radiation environments for producing transmission factor data relevant to the situations at Hiroshima and Nagasaki. In addition, the radiation equivalency of house models used at BREN to Japanese house models and the physical basis for the nine-parameter formula have been studied. This investigation has concluded that the average gamma-ray transmission factors based on the nine-parameter formula are probably too high by about a factor of 2. The large discrepancy between the nine-parameter formula and recent estimates results from the apparent failure to properly account for the large gamma-ray dose component caused by capture gamma rays produced in the house walls by the large neutron flux present at BREN.

8717 **Resolution of singularities of the diamond difference approximation.** Abu-Shumays, I.K. (Bettis Atomic Power Lab., West Mifflin, PA). *SIAM (Society for Industrial and Applied Mathematics) Journal on Numerical Analysis;* **17**: No. 6, 794-805(Dec 1980).

The standard diamond difference approximation to the transport theory discrete ordinates equations in x-y geometry leads to singular systems of equations for cell (reflecting) and for some periodic boundary conditions. As a consequence: (a) the solutions of the matrix approximations, though unique at centers of mesh cells, are physically meaningless at cell boundaries, and (b) in general, convergence of applicable iterative methods is rather slow in comparison to the case when vacuum boundary conditions are used. To overcome these difficulties, a slightly less accurate (first order) weighted diamond difference approximation is generally applied. Often numerical schemes which set negative fluxes to zero and readjust the computations are also applied, though at an increase in the computional cost. The presence of negative flux solutions generally indicates that either the problem formulation or the mesh subdivision is inadequate. This paper shows how a proper reinterpretation of the physical boundary conditions can remove the singularity of the diamond difference discretization. It is proved that a discrete L_2-norm of the resulting numerical approximation to the transport equation has the same order of accuracy as the standard diamond difference approximation.

8718 **Numerical solutions of the Boltzmann transport equation.** Rockwood, S.D.; Green, A.E. (Los Alamos Scientific Lab., NM). *Computer Physics Communications;* **19**: 377-393(1980).

NOMAD is a computer code written in FORTRAN IV which solves the Boltzmann transport equation in energy space. The resulting solution gives the distribution function of electrons accelerated by a dc electric field and in a mixture of atomic or molecular gases. From the distribution function the transport parameters: drift velocity, average energy, diffusion coefficient and mobility are calculated for comparison with experimental data. In addition, rates of energy loss through elastic and inelastic scattering are evaluated and displayed for use in discharge kinetic models.

8719 **Fluctuations in two-dimensional six-vertex systems.** Youngblood, R.W. (Brookhaven National Lab., Upton, NY); Axe, J.D.; McCoy, B.M. pp 325-334 of Ordering in strongly fluctuating condensed matter systems. Riste, T. (ed.). New York, NY; Plenum Publishing Corp. (1980).

The character of polarization correlations in six-vertex systems will be discussed. Making use of a connection between the 1-d Heisenberg-Ising chain and the six-vertex problem, we draw upon existing results for the chain correlations to obtain information about long-wavelength polarization correlations in six-vertex models. These results are compared with a neutron scattering study of 2-d polarization correlations in the layered compound copper formate tetrahydrate. Because the six-vertex model is equivalent to a particular roughening model, these results also explicitly predict the critical behavior of that roughening model just above its roughening temperature. The results correspond to the predictions of Kosterlitz and Thouless for the phase transition in the 2-d Coulomb gas.

6550 Medical Physics

REFER ALSO TO CITATION(S) 8209, 8232, 8420, 8715

8720 **(GSF-S—789) 1980 statistical results of the official personel dosimetry service at GSF.** Drexler, G.; Eckerl, H.; Haid, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Sep 1981. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750691.

The report consists of a summary of relevant statistical data from the official personel dosimetry in 1980. Under survey were occupationally exposed persons in the states of Bavaria, Hessen and Schleswig-Holstein. The data are based on the survey of 6 067 Institutions with 55 814 persons and are derived from approx. 670 000 single measurements. The report covers informations on the institutions, on the persons as well as dosimetric values. The measuring method is described briefly with respect to dosimeters used, their range and the interpretation of values. Information on notional doses and the interpolation of values nearby the detection limits are given.

8721 **Algorithm for determining the proximity distribution from dose-averaged lineal energies.** Zaider, M. (Columbia Univ., New York); Brenner, D.J.; Hanson, K.; Minerbo, G.N. *Radiation Research;* **91**: No. 1, 95-103(Jul 1982). Contract AC02-78EV04733;W-7405-ENG-36.

An algorithm is proposed for determining the proximity distribution of energy transfers from measured dose-averaged lineal energies. The applicability of the algorithm is illustrated with a calculation for a ^{60}Co beam based on a set of experimental y/sub D/ values. Pracical methods for using the proposed algorithm are discussed.

8722 **An interpretation of some biological results obtained in range-modulated negative pion beams.** Brenner, D.J.; Dicello, J.F.; Zaider, M. *International Journal of Radiation Oncology, Biology and Physics;* **8**: No. 1, 121-126(Jan 1982).

Recent biological data show little change in relative biological effectiveness (RBE) across the peak region of range-modulated pion beams in contrast to previous works which showed increasing RBE with depth. These biological results are shown to be consistent with each other and with previously measured microdosimetric data. The differences are attributed to differences in the lateral spread of the beams. Large lateral distributions result in an increased dose as a result of neutrons emitted in pion "stars," an effect that is quantified using a high-energy neutron transport code. For a large beam which is of the type used in therapy, the neutron dose is as much as 50% of the total "star" dose and of the high linear energy transfer (LET) dose, this percentage increasing with increasing peak volume. Preliminary measurements are in agreement with the calculated results. The rapid increase in neutron dose with field size should be an important factor in pion treatment planning.

8723 **Development of the dosimetric program, T65D values.** Auxier, J.A. (Oak Ridge National Lab., TN). pp 6-24 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982). Contract W-7405-ENG-26.

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

In 1956 the Health Physics Division of Oak Ridge National Laboratory undertook the task of developing a method of evaluating the radiation doses received by the survivors of the nuclear bombings of Hiroshima and Nagasaki, Japan. Data for this project were obtained from nuclear weapons tests, Operation BREN, laboratory experiments, physical surveys in Japan, and calculational studies. The approach to the problem was as fundamental as possible, with emphasis on quantitative measurements and calculations of the energy, angular, and spatial distributions of weapons radiations in an air-over-ground geometry. Spatial distributions of dose in various shields, including Japanese dwellings, were measured. Techniques were developed in Japan for verifying the locations of survivors and accurately describing their shielding environments. Simple empirical equations were developed which permitted the calculation of the shielding factors for Japanese residential-type structures.

8724 **Self-shielding factors.** Kaul, D.C. (Science Applications, Inc., Schaumburg, IL). pp 209-222 of Reevaluations of dosimetric factors: Hiroshima and Nagasaki. Bond, V.P.; Thiessen, J.W. (eds.). Oak Ridge, Tennessee; Technical Information Center (1982).

From Symposium on neutron dosimetry; Germantown, MD, USA (15 Sep 1981).

Throughout the last two decades many efforts have been made to estimate the effect of body self-shielding on organ doses from externally incident neutrons and gamma rays. These began with the use of simple geometry phantoms and have culminated in the use of detailed anthropomorphic phantoms. In a recent effort, adjoint Monte Carlo analysis techniques have been used to determine dose and dose equivalent to the active marrow as a function of energy and angle of neutron fluence externally incident on an anthropomorphic phantom. When combined with fluences from actual nuclear devices, these dose-to-fluence factors result in marrow dose values that demonstrate great sensitivity to variations in device type, range, and body orientation. Under a state-of-the-art radiation transport analysis demonstration program for the Japanese cities, sponsored by the Defense Nuclear Agency at the request of the National Council on Radiation Protection and Measurements, the marrow dose study referred to above is being repeated to obtain spectral distributions within the marrow for externally incident neutrons and gamma rays of arbitrary energy and angle. This is intended to allow radiobiologists and epidemiologists to select and to modify numbers of merit for correlation with health effects and to permit a greater understanding of the relationship between human and laboratory subject dosimetry.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 7911, 8083, 8084, 8240, 8606, 8719

8725 **(DESY-SR—81/03) Laue photography of fine crystalline particles.** Asaf, U.; Kalman, Z.H.; Steinberger, I.T.; Graeff, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1981. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750371.

An experimental method is described for the determination of crystallite dimensions in polycrystalline materials. It is based on studying the geometry of streaks that appear in powder photographs taken with white X-ray radiation. A detailed analysis is presented that includes a differentiation between these streaks and somewhat similar streaks due to asterism. Results by synchroton radiation from powder samples of various materials are discussed and compared with the crystallite dimensions obtained by other methods. It is demonstrated that the method is largely complementary to measurements by electron microscopy and that it is particularly useful for the determination of the thickness distribution of thin (0.005-0.5 μm) platelets, oriented parallel to the substrate.

8726 **(UCRL—86966) Similarities of dislocation-dependent deformation and thermodynamic models for solids and liquids.** Stout, R.B. (Lawrence Livermore National Lab., CA (USA)). Jul 1982. Contract W-7405-ENG-48. 9p. (CONF-830104—2). NTIS, PC A02/MF A01. Order Number DE82018066.

From International conference on constitutive laws for engineering materials: theory and application; Tucson, AZ, USA (10 Jan 1983).

The model describes dislocation density by a scalar function for the possible dislocation species. A Boltzmann-type equation can be developed to model the evolution of the scalar dislocation density function. The relative deformation between two atoms is modelled by a functional. This relative deformation has a continuum part and a discontinuum part. The functional models the discrete discontinuities of displacement between atomic planes as a result of dislocation kinetics. Physically, the elastic response of a material, whether solid or liquid, is modelled by the lattice structure deformation; and the non-elastic response, which is plasticity for solids or fluidity for liquids, is modelled by the dislocation dependent functional. The thermodynamic model assumes the existence of an internal energy functional. The methodology is primarily that established by Gibbs. By including the scalar dislocation density function as an argument in the internal energy functional, the Gibbs methodology leads to a definition for a thermodynamic chemical potential for dislocation kinetics. The results replace some plasticity concepts by thermodynamic concepts and illustrate the similarities of solid-liquid flow models with respect to the density of dislocations and the thermodynamic chemical potential for dislocation kinetics. The

formalism of Onsager suggests an irreversible thermodynamic model over a set of nonequilibrium deformation processes.

8727 **Theory of the one-dimensional electron gas.** Emery, V.J. (Brookhaven National Lab., Upton, NY). pp 247-303 of Highly conducting one-dimensional solids. Devreese, J.T.; Evrard, R.P.; van Doren, V.E. (eds.). New York, NY; Plenum Publishing Corp. (1979).

As a first step in the study of organic metals, a discussion of exact solutions or controlled approximations of the properties of an electron gas in one dimension is presented. This is a limited goal. For the most part, the effects of phonons and molecular vibrations will be ignored and there will be little consideration of coupling between chains or attempt to use the results to parametrize the experiments. Three main approaches have been widely used in this field: Bethe's ansatz, the renormalization group method, and boson representations. The first has produced many important results, some of which will be used later, but it does not tell us as much as we should like to know about the correlation functions which are so important for revealing the nature of the collective motion or the possible phase transitions which the system may undergo. On the other hand the other two methods do this very nicely even though they omit almost all effects of the lattice. Despite the importance of Bethe's ansatz, this chapter will concentrate largely upon the other two methods, for they embody the most recent technical developments and also have a bearing on problems of high-energy physics. The boson representations are actually much simpler to use than many of the more common methods of many-body theory and, for this reason, a rather detailed account of the technique so as to give the interested reader the necessary background to follow the subsequent discussion and to carry out similar calculations for himself is given. A qualitative survey of some of the physical questions to be addressed is presented.

6561 Superconductivity

8728 **Thermoelectric effects in superconductors.** Falco, C.M. (Argonne National Lab., IL); Garland, J.G. pp 521-540 of Nonequilibrium superconductivity, phonons, and kapitza boundaries. Gray, K.E. New York, NY; Plenum Publishing Corp. (1981).

A great deal of recent work has now established that there are thermoelectric effects which are actually unique to the superconducting state. The study of these effects provides an interesting and fruitful way to investigate the non-equilibrium dynamics of the superconducting state. This paper introduces the two fluid model of superconductivity which is analogous to that commonly used to describe super-fluid helium. The impossibility of observing normal thermoelectric coefficients in superconductors is shown to follow from the spatial rigidity of the electrochemical potential. Recent electrostatic measurements of the chemical potential in superconductors are also discussed. We discuss attempts to study the fountain effect in superconductors; in principle, these measurements, which make use of the asymmetry in the current-voltage characteristic of Josephson junctions, should allow determination of the thermopower of a superconductor. Recent measurements of the thermoelectrically generated flux in bimetallic superconducting rings are summarized. This effect, which is based upon the concept of fluxoid quantization, yields information about the non-equilibrium quasiparticle distribution of a superconductor. The accousto-electric effect, which is conceptually similiar to the thermoelectric flux effect, is described. Very recently, there has been a flurry of theoretical and experimental research on thermoelectric charge imbalance effects in superconducting thin films. This work is reviewed.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 7964, 8566, 8567, 8568, 8569, 8569, 8572, 8578

8729 (Juel-Spez—146, pp 98-99) **Adiabaticity in the path integral approach.** Reinhard, P.G.; Reinhardt, H.; Goeke, K. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8730 **Test of quantum mechanics by neutron interferometers.** Rauch, H. (Atominstitut der Oesterreichischen Universitaeten, Vienna, Austria). *Hadronic Journal;* 5: No. 3, 729-732(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Since its advent in 1974, the neutron interferometry technique is a powerful tool for tests of quantum mechanics by matter waves. High order interference pattern could be observed and an upper limit for nonlinear terms in the Schroedinger equation has been given. The 4π-symmetry of a spinor wave function was verified in 1975. Afterwards a precision measurement of this 4π-symmetry effect has been performed which yields, after corrections for the new values of the fundamental constants, a periodicity factor of $\alpha = 715.87 +- 3.8$ deg which does not include the expected 720 deg within its simple error limits. Alternative formulations of quantum mechanics predict a deviation of the 4π-periodicity factor in the region of strong interaction. Therefore, a precision measurement of the influence of strong interactions is proposed where the spinor rotation is observed within the region of additional strong interactions caused by a nonmagnetic material of heavy nuclei inserted alternatively into the beam paths of the interferometer. It is expected to reach an accuracy concerning the additional phase shift in the range of 10^{-5} which corresponds to deviation factors within the region of strong interactions of about 20% from the standard formulation. Various factors limiting the accuracy are discussed.

8731 **Lie-admissible spin algegra for arbitrary spin and the interaction of neutrons with the electric field of atoms.** Eder, G. (Atominstitut der Oesterreichischen Universitaeten, Vienna, Austria). *Hadronic Journal;* 5: No. 3, 750-770(Apr 1982). (CONF-820136—). Contract AC02-80ER10651.

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

A Lie-admissible spin algebra over one mutation parameter rho is discussed for arbitrary spin quantum number s. It is applied to s = 1/2, 1, and 3/2. The effects of a magnetic field, of the electric field, and of the electric polarizability are considered for slow neutrons.

8732 **Bifurcations, instabilities and catastrophes associated with non-potential systems.** Huseyin, K. (Univ. of Waterloo, Ontario). *Hadronic Journal;* 5: No. 3, 931-974(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

An overall view of the instability behavior of autonomous systems, including linear as well as non-linear theories, is presented. The differences and the contrasts in the behavior of potential and non-potential systems and their implications are brought into sharp focus within the context of a linear formulation which yields the stability boundary in many practical cases. Thus, conservative, pseudo-conservative, gyroscopic and circulatory systems are identified and discussed together with the effect of damping. A nonlinear theory concerning bifurcations, instabilities and catastrophes of all these systems is outlined from a unified point of view. The concepts of general and special critical points are used to identify, characterize, and classify the critical divergence conditions which lead to static bifurcations. It is demonstrated analytically that the phenomena like fold, cusp, etc. catastrophes associated with potential systems arise in these more general systems as well. Flutter instability and Hopf bifurcation leading to limit cycles are discussed briefly. An example concerning chemical processes is presented.

8733 **Geometrical treatment of non-potential interactions: the exterior variational calculus, dynamical systems, physical 1-forms and variational selfadjointness.** Trostel, R. (Technische Universitaet, Berlin, Germany). *Hadronic Journal;* 5: No. 3, 1023-1119(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

A mathematical objective of this paper is to provide geometrical formulation of the integrability conditions for the existence of an action functional, that is, to provide a geometrical counterpart (similar to that by Abraham, Marsden, and Hughes) of the variational and functional approach to self-adjointness. This objective is achieved via the exterior variational calculus, an exterior differential calculus on the vector space of functions depending on time or space time, using from the outset extensively the concept of functional differentiation as its foundation. Variational self-adjointness equals the variational closure of the physical 1-form, the vanishing of a generalized curl-operation applied to the equations of motion. The convenience of this more formal approach is demonstrated, not only when deriving the conditions of variational self-adjointness for materials of differential type of arbitrary order (particles or fields), using roughly no more than Dirac's δ-distributions, but also when treating materials of a broader class (including causal and acausal constitutive functionals, materials of rate type, integral type, etc.). A physical objective of this paper is achieved by pointing out that, as physics is primarily concerned with the solutions of the evolution equations, i.e., with the set of the zero points of the physical 1-form, an equivalence relation among the physical 1-forms on the infinite dimensional vector space of functions is constructed by leaving the set of their zero points unchanged. Using this result, a direct Lagrangian universality is indicated and an almost one presented. Moreover, all physical 1-forms connected by invertible supermatrices (thus mixing the evolution law of different times or space-time) are equivalent. Choosing these supermatrices to be diagonal in time or space-time yields the indirect analytical representation factors.

8734 **Nonpotential scattering theory and Lie-admissible algebras: time evolution operators and the S-matrix.** Mignani, R. (Istituto di Fisica dell'Universita, Rome, Italy). *Hadronic Journal;* 5: No. 3, 1120-1139(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

In this paper we initiate the study of a non-potential scattering theory within the framework of Lie-admissible formulations. By working in a time-dependent approach, we assume as starting point the usual definition of S-matrix as the time development operator connecting states of our system (supposed interacting through non-potential forces) in the infinite past to states in the infinite future. It is shown that the Lie-admissible generalization of quantum mechanics, needed to take into account nonconservative forces, leads to two different, non-unitary evolution operators in Schroedinger's representation, U/sub +/ and U/sub -/, describing, respectively, motion forward and backward in time. This implies the existence of two different S-matrices (and, therefore, of two different cross sections) for a given reaction and the inverse (time-reversed) one. Then, one expects a violation of time-reversal invariance whenever nonpotential forces are involved, predictably for strong (nuclear and hadronic) interactions, in agreement with some recent experimental results in nuclear physics. Lie-admissible generalizations of Schroedinger's equations, suggested by the equations of motion for U/sub +/ and U/sub -/, are proposed. Both U/sub +/ and U/sub -/ operators satisfy a Volterra-like integral equation, which can be expanded, under suitable assumptions, in a Neumann-Liouville series. By introducing the operators of chronological and antichronological ordering, one can express both the direct and inverse scattering matrix in the form of a perturbative expansion. The validity of the limiting procedure leading from the U-operators to the S-matrices is investigated by means of generalized Moller's operators.

8735 **Generalizations of the canonical transformation theory.** Kobussen, J.A. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). *Hadronic Journal;* 5: No. 2, 501-517(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

In this paper a brief discussion of the following subjects is presented: (1) introduction, truncated and untruncated Lagrange's and Hamilton's equations; (2) variational principles, the inverse problem and the direct universality of Birkhoff's formalism; (3) Birkhoffian systems and its transformation theory; (4) Lie-admissible and general first-order system; and (5) transformation theory for Lie-admissible and general first-order systems.

8736 **Stochastic evolution in non-conservative statistical mechanics.** Guiasu, S. (Quebec Univ., Trois-Rivieres). *Hadronic Journal;* 5: No. 2, 547-576(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The aim of the present paper is to revisit the fundamental properties of the evolution in the non-conservative statistical mechanics and to propose a new stochastic model for this evolution based on two variational principles, namely the Principle of Maximum Entropy combined with the Principle of Minimum Interdependence. The Principle of Maximum Entropy (PEM) is very well-known and extensively used for determining the best probability distribution compatible with some mean values of some random variables. The second one (PIM) proves to be a useful tool for determining the stochastic evolution compatible with the constraints given by some mixed moments (correlations, covariances, etc.). The PIM-PEM theory can be applied both in the discrete and in the continuous case, both in the phase space and in the range domain of some phase functions.

8737 **Liouville's theorem as a link between different viewpoints.** Fronteau, J. (Orleans Univ., France). *Hadronic Journal;* 5: No. 2, 577-592(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The present paper is an attempt to make a link between works in Statistical Mechanics, the majority of which have been presented at the First International Conference on Non-Potential Interactions and their Lie-Admissible Treatment, held at the University of Orleans from January 5-9, 1982. The theme of this article, which is fairly pedagogical, relies on recent results published in collaboration with A. Tellez-Arenas, P. Combis, M. Grmela, and R.M. Santilli.

8738 **Logarithmic gradient of the experimental distribution function.** Salmon, J. (Conservatoire National des Arts et Metiers, Paris, France). *Hadronic Journal;* 5: No. 2, 593-637(Feb 1982). (In French). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Statistical mechanics of the logarithmic gradient of the distribution function is studied and applied to the mobility of ions in a gas and Brownian movement.

8739 **Field versus particle description in statistical mechanics.** Grmela, M. (Ecole Polytechnique, Montreal, Quebec). *Hadronic Journal;* 5: No. 2, 638-658(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Dynamical field equations arising in statistical mechanics can be regarded as lifts (in many cases Liouville equations) of equations governing the time evolution of a particle or few particles. Three different methods leading to this alternative interpretation of dynamical field equations, their history and usefulness are reviewed.

8740 **Non-associative quantum mechanics and strong correspondence principle.** Okubo, S. (Univ. of Rochester, NY). *Hadronic Journal;* 4: No. 3, 608-633(Apr 1981). (CONF-8008162—). Contract AC02-76ER13065.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

We propose a stronger form of correspondence principle between classical Poisson-bracket formalism and quantum mechanics. Then, it is shown that the resulting quantum-mechanical operator algebra A cannot be associative but is flexible, Lie-admissible, noncommutative Jordan algebra. Moreover, its structure is uniquely determined, at least for a dynamical system, in one-dimensional space. The associated Lie algebra A^- contains a sub-Lie algebra isomorphic to a sub-algebra of Virassoro algebra for the relativistic string dual model. Our approach is purely algebraic in nature, without

any analytical notion. Also, the present algebra has some connection with Kobiris theorem on nodal algebra.

8741 **Mutation parameters of the generalized spin algebra for particles with spin 1/2.** Eder, G. (Atominstiut der Oesterreichischen Universitaeten, Vienna). *Hadronic Journal;* 4: No. 3, 634-641(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Santilli and others have proposed a generalization of the spin algebra for particles with spin quantum number 1/2. It is shown that the mutation parameters λ and μ are not independent on account of the limited eigenvalues of the spin components.

8742 **Non-associative algebras of quantum-mechanical observables.** Kapuscik, E. (Inst. of Nuclear Physics, Cracow, Poland). *Hadronic Journal;* 4: No. 3, 673-696(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

A critical examination of the original Heisenberg approach to quantum mechanics is presented. It is shown that, using the same kind of arguments as Heisenberg, it is possible to construct new non-associative algebras of quantum-mechanical observables. Two examples of such algebras are explicitly constructed.

8743 **Transformation theory for first-order dynamical systems.** Kobussen, J.A. (Zurich Univ., Switzerland). *Hadronic Journal;* 4: No. 3, 697-741(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

This paper deals with general first-order dynamical systems represented by the equation of motion x/sup i/ = f/sup i/(x,t) = S/sup ij/(x,t) δ H(x,t)/δ x/sup j/ where the Hamiltonian H, the dynamical matrix S and the force f are arbitrary, that is not necessarily of the canonical type. The Lie group of coordinate transformations and the subgroups that leave f, S, and H invariant are discussed, together with the corresponding Lie-algebra of generating vector fields. Additionally, the possibility of generating a group of coordinate transformations with an algebra of scalar fields is discussed. The paper concludes with some remarks on the relation between invariant coordinate transformations and the existence of first integrals, as well as of quantities that increase in time uniformly. Line by line, all statements in this paper can be generalized for classical fields.

8744 **Brief introduction to Lie-admissible formulations in statistical mechanics.** Fronteau, J. (Orleans Univ., France). *Hadronic Journal;* 4: No. 3, 742-753(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

The present article is a summary of the essential ideas and results published in previous articles, the aim here being to describe the situation in a schematic way for the benefit of non-specialists. The non-truncated Liouville theorem and equation, natural introduction of Lie-admissible formulations into statistical mechanics, the notion of a statistical quasi-particle, and transition towards the notion of fine thermodynamics are discussed.

8745 **Brackets of Nambu, on d-polynomials and on canonical lists of variables.** Ilamed, Y. (Soreq Nuclear Research Center, Yavne, Israel). *Hadronic Journal;* 4: No. 3, 824-830(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

In this paper we define d-polynomials which are generalized polynomials with noncommuting coefficients inserted between the variables. We show that some d-polynomials can be used as an extension of the brackets of Nambu. As a result, we obtain that n mutually commutative Heisenberg pairs of canonical variables, σ-Pauli matrices, and λ-Gell-Mann matrices can be considered in a unified way as canonical lists of variables.

8746 **Mathematical obstructions to quantization.** Chernoff, P.R. (Univ. of California, Berkeley). *Hadronic Journal;* 4: No. 3, 879-898(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Quantization is commonly viewed as a mapping of functions on classical phase space to operators on Hilbert space, preserving the Lie algebra structure and satisfying some additional physically motivated requirements. The present paper surveys the main results, old and new, concerning the existence of quantization process. Although it is possible to preserve the Lie structure, it is shown that any one of a number of reasonable additional requirements on the quantization process leads to a contradiction.

8747 **Imprimitivity theorem and quaternionic quantum mechanics.** Truini, P. (Duke Univ., Durham, NC); Biedenharn, L.C.; Cassinelli, G. *Hadronic Journal;* 4: No. 3, 981-994(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

The study of quantum mechanics in quaternionic Hilbert space is not new in physics; indeed, it goes back to the first attempts in formulating quantum mechanics from an axiomatic point of view, and later, from a more physical viewpoint, to the survey of Finkelstein et al. But recently a new physical motivation for such investigations has been given by the work of Adler in algebraic chromostatics, since it has been pointed out that quaternionic quantum mechanics, as a model of an intrinsically non-Abelian gauge theory, fits the Adler algebraic version of chromostatics. The present paper aims at a critical understanding of quaternionic quantal structure through the examination of the elementary case of a single free particle in non-relativistic space-time. We follow the suggestion by Mackey to exploit the imprimitivity theorem, together with the notion of induced representation, in deriving the theory for the free particle system, starting from the axiomatic standpoint. We show that there exists a unique unitary skew adjoint operator which commutes with all the observables. This operator not only plays the role of the imaginary unit in the complex case, but allows a complexification of the Hilbert space by the choice of any quaternionic unit.

8748 **Comment on the dynamics of $M_3$8.** Truini, P.; Biedenharn, L.C. (Duke Univ., Durham, NC). *Hadronic Journal;* 4: No. 3, 995-1017(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

We survey the possibility of describing a consistent dynamics for the formally real Jordan algebras $M_3/\sup \alpha/$, α = 1,2,4,8 of the 3 x 3 Hermitian matrices over the real, complex, quaternionic and octonionic division rings. We particularly examine in detail the dynamics for M_3^6, a quantal system which has been studied so far only from a kinematical point of view. We show that a new kind of dynamics generated by a trilinear form, and with no Hamiltonian, is the only possible description of the most general time evolution. The motion is characterized by a close analogy with the classical motion of four independent harmonic oscillators. We show that difficulties may arise in the definition of time reversal, in both the quaternionic and octonionic case, due to the nature of the underlying division ring. The suggested resolution is to adjoin an imaginary unit commuting with all elements of the Jordan algebra.

8749 **Quantum spacetime operationally based on propagators for extended test particles.** Prugovecki, E. (Univ of Toronto, Ontario). *Hadronic Journal;* 4: No. 3, 1018-1104(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

By taking into account the quantum aspects intrinsic to any operational definition of spatio-temporal relationships, a stochastic concept of spacetime emerges. In relation to its classical counterpart is realized as a stochastic mean around which quantum fluctuations become negligible only in the limit of macroscopic spacetime intervals. The test-particle propagators used in the proposed quantum concept of spacetime are derived by solving in a consistent manner the localizability problem for relativistic particles. This is achieved in the framework of the stochastic phase space formula-

tion of quantum mechanics, which in the nonrelativistic context is shown to result from systems of imprimitivity related to phase space conserved probability currents derivable from bona fide convariant probability densities in stochastic phase spaces of one particle systems, which can be interpreted as due to measurements performed with extended rather than pointlike test particles. The associated particle propagators can be therefore consistently related to coordinate probability densities measurable by the exchange of photons in between test particles from a chosen standard. Quantum spacetime is defined as the family of propagators corresponding to all conceivable coherent flows of test particles. This family of free-fall propagators has to satisfy certain self-consistency conditions as well as consistent laws of motion which inplicitly determine the stochastic geometro-dynamics of quantum space-time. Field theory on quantum spacetime retains many of the formal features of conventional quantum field theory. On a fundamental epistemological level stochastic geometries emerge as essential prerequisites in the construction of spacetime models that would be operationally based and yet consistent with the relativity principle as well as with the uncertinty principle.

8750 **Nonlinear generalization of the Floquet theorem and an adiabatical theorem for dynamical systems with Hamiltonian periodic in time.** Lochak, G. (Fondation Louis De Broglie, Paris, France). *Hadronic Journal;* 4: No. 3, 1105-1126(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

The aim of this paper is to extend the theory of adiabatical invariance to classical Hamiltonian systems with time-periodic potentials or constraints. Such a generalization has been already performed in quantum mechanics (and later on extensively applied, namely in statistical mechanics) but it was based on the Floquet theorem, i.e., use was made of the linearity of the field equations. We show, in the present paper that the main idea of the Floquet theorem can be expressed in a non-linear way. We then introduce in analytical dynamics a new concept called canonical reducibility, which is a non-linear extension of Floquet theorem and we provide a theorem asserting that a dynamical periodic system which is canonically reducible to a conservative and integrable one possesses adiabatical invariants.

8751 **Certain intriguing physical, mathematical and logical aspects concerning quantization.** Kalnay, A.J. (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela). *Hadronic Journal;* 4: No. 3, 1127-1165(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Different level sources of possible inconsistencies of Quantum Physics are studied. The point of view is defended that inconsistencies may arise due to improper philosophical foundations of Quantum Physics but that there is a way out to each of the up to now suggested purely mathematical inconsistencies of each of the main mathematical formulations of Quantum mechanics. An example is worked out explicitly. The point of view is also supported that even if the above statement may be correct, i.e., that no purely mathematical inconsistencies exist in each of the main mathematical formulations, it is highly worthwhile to study alternatives as those offered by the Lie-Admissible Formulations of Quantum Mechanics.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 8597, 8598, 8732, 8733, 8736, 8737, 8748

8752 **(DOE/ER/05126—173) Graphical analyses of connected-kernel scattering equations.** Picklesimer, A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Oct 1982. Contract AS05-76ER05126. 15p. (ORO—5126-173). NTIS, PC A02/MF A01. Order Number DE83002605.

Simple graphical techniques are employed to obtain a new (simultaneous) derivation of a large class of connected-kernel scattering equations. This class includes the Rosenberg, Bencze-Redish-Sloan, and connected-kernel multiple scattering equations as well as a host of generalizations of these and other equations. The graphical method also leads to a new, simplified form for some members of the class and elucidates the general structural features of the entire class.

8753 **Exponentiation and deformations of Lie-admissible algebras.** Myung, H.C. (Univ. of Northern Iowa, Cedar Falls). *Hadronic Journal;* 5: No. 3, 771-903(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The exponential function is defined for a finite-dimensional real power-associative algebra with unit element. The application of the exponential function is focused on the power-associative (p,q)-mutation of a real or complex associative algebra. Explicit formulas are computed for the (p,q)-mutation of the real envelope of the spin 1 algebra and the Lie algebra so(3) of the rotation group, in light of earlier investigations of the spin 1/2. A slight variant of the mutated exponential is interpreted as a continuous function of the Lie algebra into some isotope of the corresponding linear Lie group. The second part of this paper is concerned with the representation and deformation of a Lie-admissible algebra. The second cohomology group of a Lie-admissible algebra is introduced as a generalization of those of associative and Lie algebras in the Hochschild and Chevalley-Eilenberg theory. Some elementary theory of algebraic deformation of Lie-admissible algebras is discussed in view of generalization of that of associative and Lie algebras. Lie-admissible deformations are also suggested by the representation of Lie-admissible algebras. Some explicit examples of Lie-admissible deformation are given in terms of the (p,q)-mutation of associative deformation of an associative algebra. Finally, we discuss Lie-admissible deformations of order one.

8754 **Lie-admissible mutation A(r,s) of an associative algebra A.** Osborn, J.M. (Univ. of Wisconsin, Madison). *Hadronic Journal;* 5: No. 3, 904-930(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Let A be an associative algebra (possible infinite dimensional) containing an identity element, and let r,s be fixed elements of A. Let A(r,s) denote the elements of A under the new product $x \circ y = xry - ysx$, x,y element of A. In this paper we investigate the properties of the nonassociative algebra A(r,s), and the relation between A(r,s) and A. More specifically, we consider the identities satisfied by A(r,s), the relation between the ideals of A(r,s) and A. Peirce-decompositions, a theorem on the Lie structure of A and its homotopes, and a notion of module for A(r,s).

8755 **Some classical results in the theory of univalent functions.** Jung, C. (Technische Universitaet, Berlin, Germany). *Hadronic Journal;* 5: No. 3, 1184-1193(Apr 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The compact space of univalent functions and some of its extensions are considered. Along Riemanns mapping theorem several extremal problems are discussed such as Koebe's function and Bloch's constant. Six theorems are quoted concerning the possible continuation onto or across the boundary of the domain of a function which is analytic or univalent, respectively. Two topics deal with the generalization of the reflection principle and the continuation to the boundary.

8756 **History and methods of Lie-admissible algebras.** Tomber, M.L. (Michigan State Univ., East Lansing). *Hadronic Journal;* 5: No. 2, 360-430(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The condition that an algebra be Lie-admissible is weak and some strong, additional assumptions were made such as U is flexible

(x(yx) = (xy)x, x,y element of U) and U⁻ is a simple Lie algebra. For any algebra, the mappings R/sub x/: y → yx and L/sub x/: y → xy are linear transformations on the vector space of U. A flexible Lie-admissible algebra satisfies the condition: (yz) (R/sub x/ - L/sub x/) = y(R/sub x/ - L/sub x/)z + y(z(R/sub x/ - L/sub x/)). Thus R/sub x/ - L/sub x/ is a derivation on U. In a Lie algebra the mapping ad/sub x/ has the same property. This suggests the possibility of using for Lie-admissible algebras methods similar to those used for Lie algebras. It has been suggested that physical applications would demand a derivative property or that flexible Lie-admissible algebras are appropriate algebras for physics. Gradually it has been possible to relax some of the other assumptions. This progress towards a structure and classification theory has been achieved by using our extensive knowledge of Lie algebras and their representations. Beginning in 1967, R.M. Santilli suggested other approaches to Lie-admissible algebra.

8757 **Construction of examples of Lie-admissible algebras.** Benkart, G.M. (Univ. of Wisconsin, Madison). *Hadronic Journal;* 5: No. 2, 431-493(Feb 1982). (CONF-820136—). Contract AC02-80ER10651.

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

In this discussion we examine general methods of constructing Lie-admissible algebras. Many of the techniques which we survey have been known since the inception of Lie-admissible studies, many have developed as the subject has evolved especially in the last five years, and many are appearing for the first time in this article. In presenting these examples we have taken two different approaches. First we have looked for common themes to unite the seemingly disparate array of algebras in the literature. In this regard we discuss six general classes of Lie-admissible algebras: (1) algebras arising by adjoining a symmetric multiplication to a Lie algebra product; (2) deformations and cohomology extensions of Lie, associative and Lie-admissible algebras; (3) mutation algebras; (4) nodal algebras; (5) Lie superalgebras; and (6) algebras resulting from structure theorems. Our second approach is to single out particular algebras within our general classes to illustrate with special cases how some concrete calculations might proceed. The special cases studied have been chosen because of their potential physical relevance.

8758 **Realizations of infinite-dimensional Lie-admissible algebras, II.** Ilamed, Y. (Soreq Nuclear Research Center, Yavne, Israel). *Hadronic Journal;* 5: No. 2, 494-500(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

Let V/sub a/¹ and V/sub a/² denote the vector spaces over the integers spanned respectively by s/sup 1,m/(;a) and s/sup 2,m/(;a), m = 0,1,2,... . In this paper we show that V/sub a/¹ and V/sub a/² with the composition laws 1 superimposed over zero and 2 superimposed over 0, respectively are nonassociative algebras that are realizations of infinite dimensional graded Lie-admissible algebras of the right Vinberg type. The corresponding Lie algebras are a generalization of the dimensional Jacobson-Witt Lie algebras.

8759 **Geometry of Lie-admissible algebras.** Oehmke, R.H. (Univ. of Iowa, Iowa City). *Hadronic Journal;* 5: No. 2, 518-546(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

The first portion of this paper consists of basic definitions and results on manifolds, fiber bundles, connections and covariant differentiation. The purpose of this is to identify a relationship between the geometries of manifolds and some classes of algebras; in particular the class of Lie-admissible algebras. Some indication is given of how results in the theory of connections can be applied to the study of Lie-admissible algebas. In the second part, some results on reductive Lie-admissible algebras are given that should have implications for the decomposition of manifolds.

8760 **Exactly solvable nonlinear equations in the theory of the minimal surfaces.** Barbashov, B.M.; Nesterenko, V.V. (Joint Inst. for Nuclear Research, Dubna, USSR). *Hadronic Journal;* 5: No. 2, 659-678(Feb 1982). (CONF-820136—).

From 1. international conference on non-potential interactions and their Lie-admissible treatment; Orleans, France (5 Jan 1982).

General solutions for the system of nonlinear equations in the second order partial derivatives with two independent variables are obtained. They determine the basic differential forms of the two-dimensional minimal surface embedded into an n-dimensional pseudo-Euclidean space.

8761 **Addenda to a nonassociative algebra bibliography.** Tomber, M.L. (Michigan State Univ., East Lansing); Smith, C.L.; Norris, D.M.; Welk, R. *Hadronic Journal;* 4: No. 4, 1318-1443(Jun 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

This is an addenda to A nonassociative algebra bibliography published in Hadronic Journal; 3: No. 1(1979). It includes some papers omitted from the original list, some papers of historical interest and those papers relating to nonassociative algebras reviewed in volumes 351-419 of the Zentralblatt fuer Mathematik. The Zentralblatt fuer Mathematik generously provided us a printout, from their data base, INKAMATH, not only of papers coded 17-XX in the mathematics subject classification but also of papers which have a secondary classification of 17-XX. Thus for the years 1978-1980 we present a bibliography which is more inclusive than the first bibliography.

8762 **Subject index of works relating to nonassociative algebras.** Tomber, M.L.; Norris, D.M.; Smith, C.L. (Michigan State Univ., East Lansing). *Hadronic Journal;* 4: No. 4, 1444-1625(Jun 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Based on the 1980 Mathematical Classification, this index classifies by subject matter, all works which are listed in A nonassociative algebra bibliography and Addenda to a nonassociative algebra bibliography. The works indexed are on nonassociative algebras, related to nonassociative algebras, or of historical interest in the development of nonassociative algebras.

8763 **Symmetries and bi-representations in the C*-algebraic framework: first thoughts.** Ghikas, D.P.K. (Univ. of Patras, Greece). *Hadronic Journal;* 4: No. 3, 658-672(Apr 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

A preliminary investigation is made about the possibility of implementing Santilli's idea of left and right action of a symmetry and time-evolution in a C*-algebraic framework. A partial result is obtained which is halfway between the usual left representation and the full left-right representation. Suggestions are provided for alternative approaches.

8764 **Jacobson-Witt algebras and Lie-admissible algebras.** Tomber, M.L. (Michigan State Univ., East Lansing). *Hadronic Journal;* 4: No. 2, 183-198(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

For any field PHI of characteristics p > 0 and integer m ≧ 1, there is a Jacobson-Witt algebra which is a Lie algebra. In this paper, all flexible Lie-admissible algebras U, such that U⁻ is a Jacobson-Witt algebra W/sub m/(p), are determined. For any W/sub m/(p), p > 2 there is exactly one such U and it is isomorphic to W/sub m/(p). There are two non-isomorphic algebras U such that U⁻ is isomorphic to $W_1(2)$, and there are no algebras U with U⁻ isomorphic to W/sub m/(2), m > 1.

8765 **Commutativity of adjoint operator algebras in simple Lie algebras.** Okubo, S. (Univ. of Rochester, NY); Myung, H.C. *Hadronic Journal;* 4: No. 2, 199-215(Feb 1981). (CONF-8008162—). Contract AC02-76ER13065.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

A multiplication is introduced in the adjoint operator space V/sub rho/(L,M) of a quasi-classical Lie algebra L. If L is a finite-dimensional simple Lie algebra over an algebraically closed field of characteristic O, and rho is an irreducible representation of L, then it is shown that V/sub rho/(L,M) is a commutative associative algebra.

8766 **Dimension and classification of general composition algebras.** Okubo, S. (Univ. of Rochester, NY). *Hadronic Journal;* 4: No. 2, 216-273(Feb 1981). (CONF-8008162—). Contract AC02-76ER13065.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Any finite-dimensional composition algebra A over a field F of characteristic not 2 is proven to have dimensions only 1, 2, 4, or 8. If we also stipulate that A is a flexible division algebra over a cubically closed field F, then the algegra A must be either a Hurwitz, a para-Hurwitz, or an eight-dimensional pseudo-octonion algegra. Also, it has been proven that any power-associative composition algebra over a field F of characteristic not equal to 2, and not equal to 3 must be a Hurwitz algebra, if A is finite-dimensional. Some new division algebras were constructed from any division-composition algebra.

8767 **Flexible Lie-admissible algebras with the solvable radical of A^- Abelian and Lie algebras with nondegenerate forms.** Benkart, G.M. (Univ. of Wisconsin, Madison); Osborn, J.M.; Britten, D.J. *Hadronic Journal;* 4: No. 2, 274-326(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

If A is a flexible Lie-admissible algebra, then A under the product $[xy] = xy - yx$ is a Lie algebra, denoted by A^-. This paper investigates finite-dimensional, simple, flexible, Lie-admissible algebra A over an algebraically closed field of characteristic zero, for which the solvable radical R of A^- is Abelian. The technique employed is to view A as a module for a semisimple Lie algebra of derivations, and then to use representation theory to gain information about products in A. In the final section of the paper we construct examples of simple flexible Lie-admissible algebras from Lie algebras with nondegenerate associative symmetric bilinear forms. These examples illustrate the great diversity of algebras which can occur when the assumption that R is Abelian is dropped.

8768 **Binary and ternary sedenions.** Sorgsepp, L. (Inst. of Astrophysics and Atmospheric Physics, Tartu, USSR); Lohmus, J. *Hadronic Journal;* 4: No. 2, 327-353(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

The possibility of an extension of the 8-dimensional Cayley algebra into a 16-dimensional sedenion algebra is investigated. For retaining some desirable properties, the binary sedenion algebra obtained by the Cayley-Dickson process is modified into an algebra with a ternary product. Both for binary and ternary sedenion algebras, the generalized Cauchy-Riemann and Laplace equations are written out. The finite projective geometries formed by hypercomplex sedenion units are briefly discussed. 67 references.

8769 **Some classes of flexible Lie-Jordan-admissible algebras.** Okubo, S. (Univ. of Rochester, NY). *Hadronic Journal;* 4: No. 2, 354-391(Feb 1981). (CONF-8008162—). Contract AC02-76ER13065.

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

We construct two classes of flexible algebras which are also Lie-admissible and non-commutative Jordan algebras. The first class of algebras are finite-dimensional, simple, quadratic algebras, while the second class are in general infinite-dimensional with symmetric bilinear non-degenerate associative form.

8770 **Real division algebras and other algebras motivated by physics.** Benkart, G.; Osborn, J.M. (Univ. of Wisconsin, Madison). *Hadronic Journal;* 4: No. 2, 392-443(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

In this survey we discuss several general techniques which have been productive in the study of real division algebras, flexible Lie-admissible algebras, and other nonassociative algebras, and we summarize results obtained using these methods. The principal method involved in this work is to view an algebra A as a module for a semisimple Lie algebra of derivations of A and to use representation theory to study products in A. In the case of real division algebras, we also discuss the use of isotopy and the use of a generalized Peirce decomposition. Most of the work summarized here has appeared in more detail in various other papers. The exceptions are results on a class of algebras of dimension 15, motivated by physics, which admit the Lie algebra sl(3) as an algebra of derivations.

8771 **Invariants of generalized Lie algebras.** Agrawala, V.K. (Univ. of Pittsburgh, PA). *Hadronic Journal;* 4: No. 2, 444-496(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Invariants and invariant multilinear forms are defined for generalized Lie algebras with arbitrary grading and commutation factor. Explicit constructions of invariants and vector operators are given by contracting invariant forms with basic elements of the generalized Lie algebra. The use of the matrix of a linear map between graded vector spaces is emphasized. With the help of this matrix, the concept of graded trace of a linear operator is introduced, which is a rich source of multilinear forms of degree zero. To illustrate the use of invariants, a characteristic identity similar to that of Green is derived and a few Racah coefficients are evaluated in terms of invariants.

8772 **Applications of isotopy to real division algebras.** Benkart, G. (Univ. of Wisconsin, Madison); Osborn, J.M.; Britten, D. *Hadronic Journal;* 4: No. 2, 497-529(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

In this paper we illustrate how the notion of isotopy can be used to solve various problems concerning finite-dimensional division algebras over the real numbers. In particular, we show that the 8-dimensional division algebras which have the same derivation algebra as the octonions, and hence which most resemble the octonions, are not in general isotopes of the octonions. Secondly, using a result of Hopf, we argue that every commutative division algebra is the reals or is isomorphic to a special kind of isotope of the complex numbers. Finally, by considering a certain class of algebras, we show how isotopy is a useful tool for determining necessary and sufficient conditions on the multiplication constants in order to have a division algebra.

8773 **Lie-admissibility of vector matrix algebras.** Ko, Y. (Seoul National Univ., Korea); Kang, B.L.; Myung, H.C. *Hadronic Journal;* 4: No. 2, 530-549(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Lie-admissibility is investigated for a 2 x 2 matrix algebra with entries in an algebra over a field F equipped with a symmetric bilinear form. When the bilinear form is nondegenerate and invariant, it is shown that this 2 x 2 vector matrix algebra is Lie-admissible if and only if it is either the 2 x 2 matrix algebra over F or a 4-dimensional simple nonflexible Lie-admissible algebra over F.

8774 **Lie-admissible algebras with specified automorphism groups.** Oehmke, R.H. (Univ. of Iowa, Iowa City); Oehmke, J.F. *Hadronic Journal;* 4: No. 2, 550-579(Feb 1981). (CONF-8008162—).

From 3. workshop on Lie-admissible formulations; Boston, MA, USA (4 Aug 1980).

Let a be an algebra with products indicated by uv. To each algebra a we associate an algebra a^- which is the same vector space as a but whose product is defined by [u,v] = uv - vu. If a^- is a Lie algebra, we say that a is a Lie-admissible algebra. The class of all Lie-admissible algebras is a very broad class in the sense that individual members appear to have very disparate underlying structures. In order to gain greater insight into this structure, we have constructed a number of examples lying in a proper subclass of the class of Lie-admissible algebras. Since our interest in the general problem has been motivated by physical considerations, we have let this same interest determine the type of examples we sought. We have confined our attention to the class of algebra a for which a^- is su(3,F). This choice not only kept the underlying computations tractable but also kept a high potential for possible applications. All of the examples we have given admit a group of automorphisms induced by conjugation by 3 x 3 upper triangular matrices whose diagonal elements are ones. We show that these examples form a basis for all such algebras. The derivation of these results is highly computational. While it would be inappropriate to record here each step of these computations, we have attempted to give some indication of our computational process and some indications of the less obvious directions we might have taken.

6590 Communication, Education, History, And Philosophy

8775 **(LA-UR—82-3170) Early history of physics with accelerators.** Anderson, H.L. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 61p. (CONF-820757—1). D. Order Number DE83001982.

From International colloquium on the history of particle physics; Paris, France (21 Jul 1928).

Portions of document are illegible.

The early history of physics at accelerators is reviewed, with emphasis on three experiments which have had a profound influence on our veiw of the structure of matter: The Franck and Hertz experiment opening practical ways of studying nuclear disintegration, and the discovery of the del^{++} isobar of the proton by Fermi and collaborators, revealing structure in the nucleon. Fermi's work is illustrated by pages from his notebooks.

70 FUSION ENERGY

8776 **Fusion: science, politics, and the invention of a new energy source.** Bromberg, J.L. Cambridge, MA; MIT Press (1982). 367p. (DOE/ET/52002—T2). MIT Press, 28 Carleton St., Cambridge, MA 02142 $30.00. Contract AC02-76ET52002.

The history of the magnetic fusion research program is described. The book carries the story from the programs inception in 1951 under the auspices of the Atomic Energy Commission through the reformulation of its goals in 1978 under the new Department of Energy. (MOW)

7001 Plasma Research

REFER ALSO TO CITATION(S) 8848, 8858

8777 **(AD-A—114578/8) Stability theory of a confined toroidal plasma. Part II. Modified energy principle and growth rate. Technical summary report.** Laurence, P.; Shen, M.C. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Mar 1982. 29p. NTIS, PC A03/MF A01.

Based upon the existence and uniqueness of a solution to the linearized Lundquist equations established previously, the modified energy principle for the sigma-stability of a confined toroidal plasma is rigorously justified. A variational principle is developed to find the infimum of sigma, and an estimate for the maximum growth rate is obtained. The results are also extended to a diffuse pinch and a multiple tori plasma.

8778 **(AD-A—114599/4) Stability theory of a confined toroidal plasma. Part I. Existence and uniqueness. Technical summary report.** Laurence, P.; Shen, M.C. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Mar 1982. 65p. NTIS, PC A04/MF A01.

The linear MHD stability of a confined plasma is generally studied by means of energy principles. Up to date, these energy principles have never been justified rigorously, and the existence of a solution to the linearized equations is also tacitly assumed. In this report, based upon a variational approach, we shall first establish the existence and uniqueness of a generalized solution to the linearized Lundquist equations for a toroidal plasma confined in a conducting shell. In a subsequent report, the so-called modified energy principle, which includes linear energy principle as a special case, will be justified rigorously and a solid foundation will then be made for application of these energy principles to the linear MHD stability of a confined plasma.

8779 **(DOE/ER/53107—T1) Boundary layer studies related to fusion theory. Final report.** (JAYCOR, San Diego, CA (USA)). 29 Sep 1981. Contract AC01-80ER53107. 70p. NTIS, PC A04/MF A01. Order Number DE82021083.

The described work studied the boundary between closed and open field lines in EBT geometry, with emphasis on the microstability properties. These properties were established primarily for drift waves in the lower hybrid range of frequencies. The transport due to these modes was evaluated by a self-consistent treatment, using quasilinear models in a plasma diffusion code. The model was benchmarked against the EDT experimental results from ORNL and the sensitivity to transport model established. Viscosity was estimated to be negligible compared with anomalous transport. Drift wave turbulence gave a boundary layer size much more consistent with experiment than either collisional transport or Bohm diffusion.

8780 (EUR—7425(Pt.1), pp 127-141) **Linear and quasilinear theory of ECH by extraordinary waves.** Airoldi-Crescentini, A.; Lazzaro, E.; Lontano, M.; Maroli, C.; Orefice, A.; Pozzoli, R.; Ramponi, C. (EURATOM-CNR Association, Milano (Italy)); Petrillo, V. (Istituto di Scienze Fisiche, Milano (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

This paper is concerned with theoretical results obtained in the analysis of propagation and heating by extraordinary electromagnetic waves (XM) in a tokamak plasma. The emphasis is on moderate size tokamaks, i.e., typically, on tokamaks with toroidal magnetic field on the axis Bsub(T)(0) approximatelly 10 kG and electron temperature peak values Tsub(e)(0) of some hundreds eV.

8781 (EUR—7425(Pt.1), pp 143-158) **Electron cyclotron heating: theoretical aspects.** Bornatici, M. (Universita di Pavia (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The propagation of electromagnetic waves in a plane-stratified, cold plasma, the heating rate, and the plasma transport induced by electromagnetic waves are investigated with reference to electron cyclotron heating.

8782 (EUR—7425(Pt.1), pp 159-165) **Report on joint ECE-ECRH workshop held at Oxford, July 1980.** Riviere, A.C. (EURATOM-UKAEA Association, Abingdon, Oxon (United Kingdom)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

There are several areas of common interest in the fields of electron cyclotron emission (ECE) and electron cyclotron resonance heating (ECRH). A joint ECE-ECRH Workshop was held in Oxford in July of this year to bring together experts in these two fields. A brief report is given on the proceedings with emphasis on the subjects directly relevant to this conference.

8783 (EUR—7425(Pt.1), pp 167-173) **Gyrotron heating in the Culham Levitron.** Alcock, M.W.; Ainsworth, N.R.; Bradford, R.E. (EURATOM-UKAEA Association, Abingdon, Oxon (United Kingdom)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Power from a 28 GHz gyrotron has been applied to the Culham Levitron. Up to 130 kW has been used at both second and fundamental resonance field conditions. At the second harmonic, absorption is weak due to low electron temperature and can be explained by non-resonant collisional damping. At the fundamental the average electron density reached is such that $\omega p^2/\omega^2 = 0.9$ but the electron temperature remains low (approximately 10 eV). During the discharges N_2 neutrals are evolved from cryogenic surfaces and as a result power lost by radiation increases. It is expected that linear conversion at the upper hybrid resonance will be the main absorption process at the fundamental but under these conditions Bernstein waves generated at the hybrid resonance will be collisionally damped in a distance short compared to the plasma dimensions. The measured plasma profiles are consistent with the power being deposited in that manner.

8784 (EUR—7425(Pt.1), pp 175-180) **Electron cyclotron heating and preionization experiments using NRL 35 GHz gyrotrons.** Read, M.E.; Gilgenbach, R.M.; Arfin, B. (Naval Research Laboratory, Washington (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Research on the use of gyrotrons for electron cyclotron heating and preionization in Tokamaks is described. The program consists of research and development on gyrotrons, and their use in ECH experiments. Recently, experiments using an 100 kW, 20ms, TE_{01} gyrotron were completed on the ISX-B Tokamak at ORNL. We summarize the results of these, in which 60% absorption, resulting in a 50% rise in the electron temperature, was achieved. Currently, ECH experiments on the Versator-II Tokamak at MIT are being performed. These experiments are aimed toward a detailed examination of the physics of ECH, including the effects of polarization and injection angle. Plans for and results from this effort, as well as those for a highly efficient, 35 GHz, 300 kW gyrotron to be used in these experiments will be presented.

8785 (EUR—7425(Pt.1), pp 181-186) **Electron cyclotron resonance heating in CLEO stellarator.** Lloyd, B. (Oxford University (UK)); Dellis, A.N.; Bradley, J.E. (EURATOM-UKAEA Association, Abingdon, Oxon (UK)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Experiments on plasma production and on the heating of existing ohmically heated hydrogen plasmas have been performed in CLEO stellarator using up to approximately 15 kW of power from a 17.5 GHz klystron (electron cyclotron resonance at 6.25 kG), injected in both the ordinary and extraordinary modes in pulses of duration up to 100 ms. In the microwave-produced plasmas the electron energy confinement time is directly measured to be about 1 ms which is close to the values obtained in CLEO by ohmic heating and to those obtained in tokamaks operating at similar low densities. The estimated heating efficiency for injection into existing ohmically heated plasmas is typically in the range 10-30%. The heating mechanism is thought to involve mode conversion, at the upper hybrid resonance, of the extraordinary electromagnetic wave to an electron Bernstein wave.

8786 (EUR—7425(Pt.1), pp 187-191) **Electron cyclotron plasma heating experiments on FT-1 tokamak.** Bulyginsky, D.G.; Golant, V.E.; Larionov, M.M. (A.F. Ioffe Physico-Technical Institute, Leningrad (USSR)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Electron cyclotron resonance heating (ECRH) using the gyrotron generator (30 GHz, 100 kW, 2ms) was studied on the FT-1 Tokamak. A new antenna, launching the wave from the stronger magnetic field side of a torus (internal antenna) was used. Internal and external antennas were compared in a wide range of plasma densities. The former were found to be more efficient in a dense plasma. Microwave heating was obtained up to the mean density of $1.8.10^{13}$ cm^{-3}, far exceeding the critical density of a 30-GHz wave. ECR absorption and linear transformation to a plasma ware are considered as heating mechanisms. More complete results are now reported. The efficiency of ECRH at the fundamental cyclotron frequency was studies in a wide range of plasma densities. Internal and external antennas were used for comparison. The dependence of ECRH on the position of a resonance zone in a plasma volume was also studied.

8787 (EUR—7425(Pt.1), pp 193-200) **Electron cyclotron heating and preionization in WT-1 Tokamak.** Tanaka, S.; Cho, T.; Nakamura, M.; Kubo, S.; Suzuki, S.; Terumichi, Y.; Hamada, Y. (Kyoto University (Japan)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Injecting a high power microwave into the WT-1 tokamak plasma, the local electron cyclotron heating is observed. Further, the microwave preionization of tokamak discharge at the electron cyclotron resonance is shown to be very useful to the reduction of the loop voltage in the early stage of the suppression of the production of runaway electrons in the quasi-steady stage.

8788 (EUR—7425(Pt.1), pp 201-205) **Electron cyclotron heating for current profile control of non-circular plasmas.** Chan, V.S.; Davidson, R.; Guest, G.; Hacker, M.; Miller, L. (General Atomic Company, California (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Electron Cyclotron Heating (ECH) offers a promising approach to modifying the radial profiles of electron temperature and plasma current in tokamaks to increase the ideal MHD beta limits and permit experimental access to particular noncircular cross-section tokamaks that cannot be achieved with the peaked current profiles characteristic of ohmically heated tokamaks. We use a one-and-one-half-dimensional, time-dependent transport model that incorporates a self-consistent model of electron cyclotron power absorption to study the temporal evolution of electron temperature and plasma current profiles and the resulting noncircular equilibria. Startup scenarios for high-beta dees and doublets are investigated with this transport modeling.

8789 (EUR—7425(Pt.1), pp 207-212) **Theoretical studies of electron-cyclotron heating in ELMO Bumpy Torus.** Batchelot, D.B.; Goldfinger, R.C. (Oak Ridge National Laboratory, Tennessee (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The basic features of microwave propagation and electron-cyclotron damping in ELMO Bumpy Torus devices have been investigated to provide and understand the heating of the toroidal core plasma component. We present cyclotron damping calculations for nonstratified plasma geometry representative of the actual EBT configuration.

8790 (EUR—7425(Pt.1), pp 213-218) **Parametric excitation effects on the electron cyclotron heating in high field Tokamak.** Chou, Y.M.; Tsai, S. (Academia Sinica, Beijing (China)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Several possible parametric decay channels are studied in high field and dense tokamak range. It is found that for the high power nearly perpendicular incident electron cyclotron wave parametric processes may occur before encounters the linear mode-conversion-layer. The pump wave decays into an ion Bernstein wave or a lower hybrid wave is most probable.

8791 (EUR—7425(Pt.1), pp 219-224) **Electron cyclotron waves in suprathermal plasmas.** Farina, D.; Lontano, M.; Pozzoli, R. (EURATOM-CNR Association, Milano (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

We are interested in the computation of the absorption coefficient of electron cyclotron waves for an electron distribution which is consistent with values of the streaming parameter xi = usub(e)/vsub(The) (where usub(e), vsub(The) are the electron drift and thermal velocities, respectively) xi < or approximately 0.1, as observed in many operational regimes of tokamak devices. For sake of simplicity, we consider here perpendicular propagation only, and takes as a model distribution a truncated Spitzer function in the frame of the Lorenz model. Part 2 deals with analytical and numerical computations relevant to the problem. The results are briefly discussed in part 3.

8792 (EUR—7425(Pt.1), pp 225-231) **Relativistic theory of electrostatic electron cyclotron waves.** Airoldi-Crescentini, A.; Lazzaro, E.; Orefice, A. (EURATOM-CNR Association, Milano (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The relativistic dispersion relation of electron Bernstein waves is treated, removing the "classical" divergences and cutoff at normal incidence. The pertinent quasilinear equations are obtained and discussed.

8793 (EUR—7425(Pt.1), pp 233-240) **Properties of the dispersion relation for the extraordinary mode near the second electron cyclotron harmonic.** Lazzaro, E.; Ramponi, G. (EURATOM-CNR Association, Milano (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

In this paper we want to discuss the important modifications of the dispersion relation for the extraordinary mode, which occur near the second harmonic as a finite density effect. We start the analysis considering first the case of perpendicular propagation.

8794 (EUR—7425(Pt.1), pp 241-246) **Scattering of electron cyclotron resonance heating waves by density fluctuations in Tokamak plasmas.** Hui, B.; Ott, E. (Naval Research Laboratory, Washington, D.C. (USA)); Bonoli, P.T.; Guzdar, P.N. (University of Maryland (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

THis paper is devoted to the study of the effects of wave scattering on electron cyclotron heating of tokamaks as a function of the level of density fluctuations. The technique employed utilizes a ray tracing computer code scattering of the wavevector of the heating wave.

8795 (EUR—7425(Pt.1), pp 247-251) **Electron cyclotron emission from FT Tokamak.** Buratti, P.; Scovenna, M.; Tudisco, O. (EURATOM-CNEN Association, Roma (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The theory of electron emission for rays non perpendicular to the external magnetic field is presented. The effect of such rays on radiation temperature for various experimental apparatus will be evaluated and the results compared with the experimental ones concerning the runaway free discharges.

8796 (EUR—7425(Pt.1), pp 253-257) **Cyclotron emission from toroidal runaway discharges.** Lontano, M.; Pozzoli, R.; Scovenna, M. (EURATOM-CNR Association, Milano (Italy)); Buratti, P. (EURATOM-CNEN Association, Milano (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The evidence of highly suprathermal emission at the second cyclotron harmonic in a high density tokamak discharge is reported. It can be interpreted as stimulated emission driven by a coherent synchrotron deceleration process of runaway electrons. The measurements have been performed on the tokamak TTF2.

8797 (EUR—7425(Pt.1), pp 285-301) **Feasibility of igniting a thermonuclear plasma with lower hybrid heating.** Brambilla, M. (EURATOM-CEA Association, Grenoble (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The present theoretical understanding of coupling, propagation and adsorption of Lower Hybrid waves in large plasmas is briefly reviewed. Linear theory of coupling and propagation, stochastic ion heating in the vicinity of the Linear Turning point, and quasilinear electron Landau damping provide a plausible physical model to evaluate the feasibility of reaching ignition with L.H. heating. This auxiliary heating method, which is very attractive from the engineering point of view, demands a careful choice of the working parameters (frequency, antenna periodicity, etc...) to cover the large temperature excursion from an ohmically heated steady sate to ignition. The domains in which in our opinion further theoretical work is particularly needed, or comparison with experiments unsatisfactory, are also identified.

8798 (EUR—7425(Pt.1), pp 303-312) **Theory of lower hybrid heating in Tokamaks.** Fedorov, V.I. (A.F. Ioffe Physico-Technical Institute, Leningrad (USSR)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Recently much attention has been given to various theoretical aspects of LH heating. As a result, the physics of LH heating of tokamak plasmas has been considerably clarified. However, some important questions have not been discussed comprehensively yet. One of them is: how are the wave propagation, conversion and absorption modified in a real toroidal plasma as compared with the simplified model of the one-dimensional inhomogeneity. In the present paper we shall try to answer this question. First of all, using the simplest but most realistic models we shall consider the accessibility problem and the linear wave conversion in toroidal plasmas. Then, we shall compare our considerations with the accurate numerical computations published recently and shall draw some conclusions regarding the heating efficiency.

8799 (EUR—7425(Pt.1), pp 313-316) **Lower hybrid wave propagation in tokamak plasmas.** Baranov, Yu.F.; Fedorov, V.I. (A.F. Ioffe Physico-Technical Institute, Leningrad (USSR)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

It is demonstrated that, under realistic conditions, the refractive index parallel to the magnetic field varies greatly along the trajectory of a lower hybrid wave in a tokamak plasma. This variation results in a considerable change in the conditions of accessibility of the lower hybrid resonance.

8800 (EUR—7425(Pt.1), pp 317-327) **Lower hybrid wave electron heating experiments in Doublet IIA.** Freeman, R.L.; Luxon, J.L.; Chan, V.S. (General Atomic Company, California (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Experiments designed to heat electrons by Landau damping of waves at approximately twice the lower hybrid frequency have been carried out on Doublet IIA. This objective is in contrast to other lower hybrid experiments which are designed to heat ions using frequencies corresponding to the lower hybrid resonance frequency. Up to 500 kW of rf power was applied to discharges with approximately 100 kW ohmic input using parallel wavelengths chosen to optimize the spatial distribution of the power deposition based on linear or quasi-linear Landau damping. Coupling of the power to both electrons and ions was observed, but there was no indication of effective bulk heating of either species. The desired slow wave propagated into the plasma and efficient coupling of the wave energy to the plasma occurred, but this energy was poorly confined. Two possible models of the absorption and loss mecha-

nisms remain unresolved: 1) The power is coupled to energetic electrons by Landau damping and is lost via anomolous electron transport before it can thermalize. 2) The power is coupled to energetic ions and is lost by direct particle losses before it can thermalize.

8801 (EUR—7425(Pt.1), pp 329-341) **Lower hybrid heating results at 500 MHz in WEGA in the light of ion stochastic heating and electron Landau damping.** Pacher, H. (EURATOM-IPP Association-Max-Planck, Garching (Federal Republic of Germany)); Gormezano, C.; Hess, W. (EURATOM-CEA Association, Grenoble (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The previously obtained results of lower hybrid heating in the WEGA Tokamak (f=500 MHZ, Psub(HF) <= 130 kW) are reconsidered in the light of recent theories on ion stochastic heating and electron Landau damping. The parametric dependences of the observed hot ion mean energy and the HF power coupled to the ions and electrons are found to correspond to the theoretical dependences. Under reasonable hypotheses, good quantitative agreement is found. In particular, ion and electron heating may be attributed to the same coupled HF spectrum.

8802 (EUR—7425(Pt.1), pp 343-354) **Four waveguide grill experiment in Petula.** Parlange, F. (Association EURATOM-CEA, Grenoble (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

A four waveguide grill is used to launch lower hybrid waves with power up to 300 kW. Reflected power is found to be unexpectedly low after grill conditioning. Effects on a 80 kA, 2.7 tesla discharge are presented with special emphasis on ion heating. Temperature increase is a linear function of RF power up to 200 kW where saturation occurs.

8803 (EUR—7425(Pt.1), pp 355-364) **Lower hybrid RF heating experiments in the MIT Alcator-A, Alcator-C and Versator II Tokamaks.** Porkolab, M.; Schuss, J.; Takase, Y.; Chen, K.I.; Knowlton, S.; Luckhardt, S.; McDermott, S. (MIT, Cambridge, Massachusetts (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Experimental results on lower hybrid heating in the Alcator A and the Versator II tokamaks with power levels up to 90 kW are presented. In Alcator A a double waveguide grill, and in Versator II a 4 waveguide grill with arbitrary phasing are used. Also, a 6 waveguide grill experiment in Versator II is described which launches a travelling wave aimed at driving toroidal currents. The forthcoming lower hybrid heating experiment in Alcator C, utilizing four 4 x 4 waveguide arrays with power levels up to 4 MW, is also described.

8804 (EUR—7425(Pt.1), pp 365-375) **Computer modelling of RF heating.** Decyk, V.K.; Morales, G.J.; Dawson, J.M. (University of California, Los Angeles (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The utility of particle simulation in studying RF heating in plasmas is illustrated by application to lower hybrid heating. Using a 2 1/2 dimensional, electrostatic particle code, lower hybrid waves are launched at the low density boundary and propagate toward the interior. The heating looks qualitatively like stochastic heating although the decorrelation mechanism has not yet been investigated. Ion heating was found to be localized in space and only the fast ions are heated, because the accelerated ions damp the wave very rapidly. Other effects observed which are being studied include electron trapping and significant surface heating, and density modifications due to the ponderomotive force.

8805 (EUR—7425(Pt.1), pp 377-384) **Energy balance of the LHRF heating experiments on the JFT-2 Tokamak.** Imai, T.; Suzuki, N.; Fujii, T. (Japan Atomic Energy Research Institute, Tokai, Ibaraki-ken (Japan)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Recent results of efficient ion heating (2-3 eV/kW) on the JFT-2 tokamak after improvements of the RF system are presented. Discussion of the energy balance was made from the temperature and density profiles with the RF power and revealed the heating efficiency was more than 50%. Analysis of the RF power flow indicates that the rapid loss of the RF power was mostly due to parametric instabilities at the surface but it was not fatal.

8806 (EUR—7425(Pt.1), pp 385-391) **Plasma heating experiments in lower hybrid frequency range.** Nakamura, M.; Saito, T.; Ikeda, M.; Kubo, S.; Terumichi, Y.; Hamada, Y.; Tanaka, S. (Kyoto University (Japan)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Experimental results of the lower hybrid heating in a small tokamak are described. When RF power is applied, a high energy tail of ions is produced, whether or not there is the lower hybrid resonance layer (LHR-layer) in the plasma column, though the bulk ion heating is not observed. The electron temperature in the plasma surface increases, while the electrons in the center lose their energy, which is related to an impurity ion flux diffused from the outside of the plasma.

8807 (EUR—7425(Pt.1), pp 393-398) **Study of driven lower hybrid waves in the Alcator-A Tokamak using CO_2-laser scattering.** Surko, C.M.; Slusher, R.E. (Bell Laboratories, Murray Hill, New Jersey (USA)); Schuss, J.J.; Parker, R.R.; Hutchinson, I.H.; Overskei, D. (Massachusetts Institute of Technology (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Measurements are reported of the frequency and Nsub(longitudinal) spectra and the spatial distribution of the lower hybrid waves launched in plasmas in the Alcator A tokamak using a phased, two-waveguide array at microwave powers from 7 to 70 kW. The waves are found to be independent of the relative phase of the exciting waveguides, and the Nsub(longitudinal) spectrum of the waves measured in the plasma is broad for 2.6 < or approximatelyd Nsub(longitudinal) < or approximately 8, with more weight at lower Nsub(longitudinal). The waves are not localized in resonance cones. They are spread in frequency by an amount $\Delta\nu$ < or approximately 7 MHz FWHM and downshifted from the driving frequency of 2450 MHz by an amount < or approximately 2.5 MHz.

8808 (EUR—7425(Pt.1), pp 399-404) **Numerical studies of lower hybrid heating and current generation in Tokamaks using a transport code and a toroidal ray tracing code.** Englade, R.; Antonsen, T.; Porkolab, M. (Massachusetts Institute of Technology (USA)); Bonoli, P. (University of Maryland (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

We have developed a computed model of lower hybrid wave-plasma interaction which uses quasilinear theory for electrostatic waves in a straight cylinder to calculate propagation and absorption. We use this model in conjunction with a 1-D tokamak transport code to simulate lower hybrid heating in Alcator C and RF current generation in Versator II. We describe a ray tracing code used to study the propagation of lower hybrid waves in toroidal geometry, and investigate the effects of variations in longitudinal wave number on accessibility and energy deposition.

8809 (EUR—7425(Pt.1), pp 405-409) **Ray tracing of lower hybrid waves in toroidal plasmas.** Brambilla, M.; Cardibali, A. (EURATOM-CEA Association, Grenoble (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Non critical application of ray tracing to follow the propagation of Lower Hybrid waves in toroidal plasmas has lead to misunderstandings about the meaning and validity of this technique. Under appropriate conditions, ray tracing can provide information about accessibility and power deposition profiles. On the other hand, since LH waves are excited by a slow-wave antenna, ray tracing alone cannot be used to evaluate the electric field distribution, which is dominated by diffraction effects.

8810 (EUR—7425(Pt.1), pp 411-416) **Numerical solution of the ray equations for lower hybrid waves in a Tokamak.** Cardinali, A.; Brambilla, M. (EURATOM-CEA Association, Grenoble (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Ray tracing is used to construct the power deposition profile of Lower Hybrid waves in toroidal geometry. In agreement with previous work we find that the wavevector component parallel to the static magnetic field decreases on the average as the waves penetrate radially into the plasma. This can affect the accessibility of the absorption region. However, detailed analysis of one ray shows that ray tracing becomes inadequate when toroidal effects are really important (small aspect ratio, large rotational transform).

8811 (EUR—7425(Pt.1), pp 417-425) **Lower hybrid wave trajectories and heating simulation in Tokamak discharges.** Barbato, E. (Scuola Normale Superiore, Pisa (Italy)); Santini, F. (Associazione EURATOM-CNEN, Roma (Italy)); Taroni, A. (CNEN, Bologna (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The propagation of lower hybrid waves excited in a toroidal plasma has been numerically studied. The effects of toroidal geometry, finite temperature and magnetic ripples are investigated. A local input term due to lower hybrid heating is used in a 1-D transport code. Ion absorption is considered in regions close to various linear turning points, while, for electrons, an expression representing quasi-linear electron Landau damping is used. RF heating of tokamak discharges is simulated and discussed. The parameters are those of the FT device and of the projected FTU tokamak.

8812 (EUR—7425(Pt.1), pp 427-435) **Lower hybrid heating programme for Asdex.** Brinkschulte, H.; Derfler, H.; Eckhartt, D.; Leuterer, F.; Muenich, M.; Puri, S.; Schmitter, K.H. (EURATOM-IPP Association, Garching (Federal Republic of Germany)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The main objective of the lower hybrid experiment in preparation is therefore the efficient heating of the ASDEX plasma. One large access port of 60 cm diameter will be available so that a phased waveguide array ("grill") can be used. A second objective is to study parasitic effects like gas and impurity release associated with the application of large amounts of rf energy at high power densities. A third goal is to study the physics of lower hybrid heating, operating as well in the ion heating regime as in the electron heating regime, and to study methods to keep the zone of wave absorption centered inside the plasma. Simultaneous application of lower hybrid heating and neutral beam heating is possible and will allow to study their mutual interaction.

8813 (EUR—7425(Pt.1), pp 437-439) **Preparations and plans for a lower hybrid heating experiment on the PLT Tokamak.** Bernabei, S.; Hooke, W.; Martin, A.; Motley, R.; Stevens, J. (Princeton University, New Jersey (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Published in summary form only.

8814 (EUR—7425(Pt.1), pp 439-445) **Preliminary results of the measurements on microwave coherent scattering in WEGA.** Ichtchenko, G. (EURATOM-CEA Association, Grenoble (France)); Moresco, M.; Zilli, E. (EURATOM-CNR Association, Padova (Italy)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

We report some preliminary results obtained in a microwave coherent scattering experiment on L.H. heating waves in the WEGA machine. The experimental data are consistent with an electric field distribution not localized in "resonance cones". The feasibility of the measurements was checked and indications of some improvements to be made in the diagnostic method came out.

8815 (EUR—7425(Pt.1), pp 447-453) **Observation of toroidal current generation by lower hybrid wave.** Takamura, S.; Kojima, T.; Uesugi, Y.; Ushigusa, K.; Nonaka, S.; Okuda, T. (Nagoya University (Japan)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Travelling lower hybrid waves were observed to be excited with a helical antenna wound around a glass vacuum chamber in a linear test device. This helical antenna was applied on a simple torus over a quarter of the toroidal circumference. The pitch of the helix determines the phase velocity along the magnetic field, which was chosen to be a few times the electron thermal velocity. In high power experiments the toroidal current was generated in its own rf produced plasma. The electron drift has the same direction as the propagation of lower hybrid wave, and is independent of the direction of toroidal magnetic field in the case of short wavelength. The standing wave was not observed to drive an appreciable amount of current.

8816 (EUR—7425(Pt.1), pp 455-461) **Temporal evolution of nonlinear lower hybrid waves.** Karney, C.F.F. (Princeton University, New Jersey (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The nonlinear evolution of a single lower hybrid waves in two dimensions and time is considered. If the potential is taken to have the form phi(x,z,t) exp(-iωt), the equation describing the fields is ivsub(tau) - $\int$ vsub(xi)dzeta + vsub(zeta zeta) + 'v'^{2}v = 0 where v is proportional to the electric field tau to time, and xi and zeta are distances along and across the lower hybrid ray. The properties of this equation are investigated numerically. When the amplitude of the injected lower hybrid waves is sufficiently large, the following phenomena are observed: the fields do not reach a steady state even though steady-state boundary conditions are imposed; the density modulations are sufficient to cause an appreciable fraction of the incident power to be reflected; the average wavenumber of the transmitted wave is larger than of the incident wave.

8817 (EUR—7425(Pt.1), pp 463-467) **Nonresonant decay in a finite wavelength pump.** Pesic, S. (Institute "B. Kidric", Vinca, Beograd (Yugoslavia)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

In the present work we derive a general dispersion relation to second order in the pump wave amplitude for electrostatic finite wavelength pump, sidebands and low-frequency waves and analyse the effects of the additional terms in the equation on the nonresonant decay processes.

8818 (EUR—7425(Pt.1), pp 417-486) **Modeling of ICRF heating in PLT.** Colestock, P.L.; Davis, S.L.; Hosea, J.C.; Hwang, D.Q.; Thompson, H.R. (Princeton University, New Jersey (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Significant heating with the fast magnetosonic wave near the ion cyclotron frequency has been demonstrated in the present generation of tokamaks. Effective wave absorption and heating can be achieved either by using the second harmonic or by heating at the fundamental of a minority ion component. Recent experiments in PLT have facilitated the refinement of a heating model which both shows good agreement with experiment and predicts favorable scaling to hotter, denser plasmas. Details of the model, including full wave theory, power deposition, Fokker-Planck theory, and scaling are discussed.

8819 (EUR—7425(Pt.1), pp 509-517) **ICRF heating in Microtor/Macrotor.** Taylor, R.J.; Morales, G.J. (University of California, Los Angeles (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

We report on subsequent higher power experiments. Power levels up to 0.5 MW have been tried. In Macrotor this power level results in deconfinement. In Microtor, we have been limited to 100KW due to the compact nature of the device and no significant transport problems have been observed. The impurity problem appeared to be serious at first. Now we can operate with no significant impurity loss, <5% of Psub(tot), at times. In section 2 of this report, we survey the wave parameters in Microtor/Macrotor from a theoretical point of view. In section 3 heating and transport effects are discussed. In section 4, wall effects are reported. Finally, in section 5, very recent results from FIR scattering are presented in the two-ion regime.

8820 (EUR—7425(Pt.1), pp 519-539) **Mode conversion and wave damping in the low frequency range.** Grekov, D.L.; Kaladze, T.D.; Korzh, A.F.; Mikhailenko, V.S.; Pyatak, A.I.; Stepanov, K.N. (Kharkov Physical-Technical Institute (USSR)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

This report contains some results that have been obtained recently in theoretical investigations of RF plasma heating in tokamaks at $\omega <= \omega_{ci}$, at the Kharkov Physical-Technical Institute. In Section I for the one-dimensional model a simple analytical expression is obtained for the wave field distribution in conversion regions of the fast mode to the slow mode and the slow one to a plasma mode in the two ion species plasma. This expression is used to evaluate the possible beam and parametric instabilities in the transformation region. In Section II the nonlinear stage of the beam ion cyclotron instability excited by a powerful wave with $\omega << \omega_{ci}$ is considered and the estimates of the noise level and the rate of turbulent plasma heating are given. Also the magnetic field of this wave with ω approximately ω_{ci} is shown to affect essentially the parametric ion cyclotron instabilities. In Section III the ion cyclotron damping rates of fast magnetosonic waves in a tokamak are calculated, rotational transform and toroidality being taken into account. In Section IV a possible method of plasma heating in a tokamak in the very low frequency range is considered where the excitation of drift waves by an external current is used.

8821 (EUR—7425(Pt.1), pp 541-547) **Damping mechanisms and heating scenarii in the ICRF.** Jacquinot, J.; Lapierre, Y. (EURATOM-CEA Association, Fontenay-aux-Roses (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

A wave damping and heating model is presented. It permits to treat a wide range of plasma parameters and complex ion species composition. Applied to JET parameters, two selected wave scenarii are found to allow a great flexibility, in particular with respect to complex gas composition. A major results is the possibility of single pass absorption.

8822 (EUR—7425(Pt.1), pp 549-554) **Excitation and propagation of the fast wave in a two-component non-uniform plasma.** Lapierre, Y. (EURATOM-CEA Association, Fontenay-aux-Roses (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The purpose of this study is to compute the coupling of antennas in presence of plasma, and to derive the electric field distribution taking into account inhomogeneity in the magnetic field and in the density. The only calculations which have been down, up to now, were made under two kinds of assumptions very low damping or very strong radial damping. Our calculation takes into account the mode conversion as it affects wave propagation. This might be of great importance for large machines.

8823 (EUR—7425(Pt.1), pp 555-559) **Distribution function of resonant ions at ion cyclotron heating of plasma in Tokamaks.** Vdovin, V.L. (I.M. Kurchatov Institute, Moscow (USSR)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The effect of primary heating of resonant ($\omega = \omega_{Bi}$) ions of minority has been recently successfully used for ICR heating of the dense plasma of large tokamaks whose high current operation affords good energetic ion confinement and whose high density provides the effective transfer of energy to the bulk ions by means of collisions. Consequently we analyze the prospects of this scheme for tokamaks of the next generation (T-15, TFTR, INTOR).

8824 (EUR—7425(Pt.1), pp 561-567) **Investigation of fast-wave heating of large Tokamaks by the ray-tracing technique.** Bhatnagar, V.P.; Koch, R.; Geilfus, P.; Evrard, M. (EURATOM-Etat Belge Association, Bruxelles (Belgium)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The fast-wave ion-cyclotron resonance heating of a tokamak is studied using the ray-tracing technique under the geometric optics approximation. A general method of solution to the problem is exhibited by making a complete connection between the antenna radiation, propagation and absorption of the wave energy inside the plasma. An initial condition for starting the rays is obtained by computing the constant-phase surfaces from the field radiated by the antenna. The results of a computer code based on a realistic plasma description are shown both as an example and as a feasibility test of the method.

8825 (EUR—7425(Pt.1), pp 569-575) **Field and ray analyses of antenna excitations in ICRF heating of large Tokamaks.** Bers, A. (Massachusetts Institute of Technology, Cambridge (USA)); Jacquinot, J. (EURATOM-CEA Association, Fontenay-aux-Roses (France)); Lister, G. (EURATOM-IPP Association, Garching (Federal Republic of Germany)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

We present analytical and computational techniques for determining the electromagnetic fields and associated power flow excited by antenna systems external to large Tokamak plasmas. The finite poloidal and toroidal extension of the poloidal antenna current is modeled by a superposition of current sheets placed at a fixed radius outside the plasma. Antennae both with and without a screen between the current sheet and the plasma are considered. The plasma is modeled by its cold dielectric tensor and inhomogeneous density and applied magnetic field. For large Tokamak plasmas in which the plasma dimensions are large compared to the antenna, the field excitation problem can be considered approximaterly in slab geometry. The field solution of this problem which we present, gives the electromagnetic fields excited in the edge plasma by the antennae and includes the effect of the cutoffs which may exist in this region. To proceed further into the plasma we consider a ray tracing analysis. Starting from an equiphase surface of the excited fields in the edge plasma, the group velocity rays can be followed in full toroidal geometry up to the cyclotron singular resonance region where the power is deposited in the particles. Both the amplitude and phase of the fields can be established in the vicinity of the singular surface so that the power deposition profile can be eventually calculated.

8826 (EUR—7425(Pt.1), pp 577-585) **Ion cyclotron resonance heating (ICRH) of an EBT with periodic boundary conditions.** Mullen, J.H.; Owens, T.L.; Huddleston, P.L.; Zeisel, K.S.; Gamble, W.K. (McDonnell Douglas Corporation, St. Louis, Missouri (USA)); Colestock, P.L.; Hosea, J.C. (Princeton University, New Jersey (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

An analysis of fast wave propagation in a cylindrical magnetoplasma with periodic boundary conditions approximating those of the Elmo Bumpy Torus is presented. The analysis shows that for the m=-1 poloidal mode and for EBT-S parameters (n < or approximately $4x10^{12}cm^{-3}$, B=7-14 kG, and plasma radius approximately 15 cm) alternating short and long wavelength modes occur as frequency is varied in the range 2<ω/OMEGAsub(j)<8. This effect should have an important influence on wave coupling and absorption. Other results indicate good wave energy penetration for both EBT-S and EBT-P (Proof of Principle) conditions. Finally, a complete wave launching system for coupling ICHR power into EBT-S is described.

8827 (EUR—7425(Pt.1), pp 587-592) **Propagation and absorption of Bernstein waves launched using lower hybrid couplers at the ion cyclotron frequency.** Puri, S. (EURATOM-IPP Association, Garching (Federal Republic of Germany)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Various antenna configurations capable of efficient launching of the electrostatic Gross-Bernstein ion cyclotron waves at ωsub(ci) to heat a plasma are examined. This method of plasma heating combines the appeal of simple coupling, direct absorption by the ions distributed evenly over the plasma volume and insensitivity to wide variations in density and temperature during the heating phase. Conditions are described for circumventing the rather serious problem of impurity heating near the edge.

8828 (EUR—7425(Pt.1), pp 593-603) **Ion Bernstein wave heating via a wide k(longitudinal)-spectrum wave guide system.** Ono, M.; Stix, T.H.; Wong, K.L.; Horton, R. (Princeton University, New Jersey (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

A reactor heating concept which utilizes a waveguide-launched ion Bernstein wave in the ion-cyclotron range of frequency is presented. Detailed calculations on wave-launching, transformation, propagation and absorption yield a favorable outlook for heating large size, hot-dense tokamak reactor plasmas to ignition temperatures by a relatively simple waveguide system. An experiment on the ACT-1 toroidal device is also presented in which the physics of mode transformation process is verified in considerable detail.

8829 (EUR—7425(Pt.1), pp 605-611) **Resonances in the ICRF regime for large toroidal machines.** Bures, M.; Hellsten, T.; Tennfors, E. (EURATOM-NE Association, Stockholm (Sweden)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Three kinds of resonances appear in the ICRF regime of a multicomponent plasma, the fundamental ion cyclotron resonance, the perpendicular ion cyclotron resonance, and Buchsbaum's ion-ion hybrid resonance. In a two-dimensional axially symmetric plasma the two last mentioned resonances are determined by ordinary differential equations. The perpendicular ion cyclotron resonance coincides with a magnetic surface, while the ion-ion hybrid resonance in general makes a small angle of the order msub(e)B/msub(i)Bp with the magnetic surfaces, except close to the fundamental cyclotron resonances, where the angle becomes large. We present here calculations of these resonances for large machines and large toroidal mode number. The position of the resonance surface as a function of the safety factor, the poloidal mode structure, the toroidal mode number, the position of the fundamental ion cyclotron resonance, the minority concentration and the effects of finite temperature are discussed. An expression for the toroidal mode number is derived for efficient heating of the interior of the plasma.

8830 (EUR—7425(Pt.1), pp 613-619) **Effect of ICRF heating on single particle confinement in Tokamaks.** Whang, K.W.; Morales, G.J.; Fried, B.D. (University of California, Los Angeles (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The simultaneous effect of ion heating and spatial diffusion due to ICRF heating in tokamak geometry is investigated from the single particle viewpoint. A set of finite difference equations which connect the magnetic moment, and phase between successive resonances are used to describe the nonadiabatic jumps produced by the RF at the resonance layer. The topology of the tokamak orbits (passing, trapped) is explicitly retained in the mapping equations. The effect of collisions is treated by a Monte-Carlo procedure that contains the slowing down and the pitch angle scattering of the minority protons with a deuterium background.

8831 (IPF—80-13) **Microinstabilities in a radially contracting inhomogeneous cylindrical plasma slab. Pt. 2. Lower-hybrid and electron-cyclotron drift instabilities in the plasma focus.** Deutsch, R.; Kaeppeler, H.J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1980. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750373.

In a preceding report the dispersion relation was derived for microinstabilities in a radially contracting inhomogeneous plasma slab. Using this and the general relations of the quasilinear theory, the lower hybrid drift instability and the electron cyclotron drift instability were studied for the collapse phase of the plasma focus. The frequency, growth rate, turbulent electron and ion heating rates and the effective collision frequency were calculated for both instabilities in parameter ranges associated with the late compression phase of the plasma focus. Simple analytical formulae were deduced for these parameters. It is shown that there exists a regime in which the lower hybrid drift induced turbulence can heat the electrons up to a few keV within approximately ten nanoseconds. This result is in agreement with the experimental observations.

8832 (IPF—81-5) **Measurement of heavy ion components in a hydrogen plasma by CO_2-laser scattering with coherent detection.** Kasparek, W.; Holzhauser, E. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Feb 1981. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750372.

The ion feature of a two-component plasma was measured with high spectral resolution using CO_2-laser scattering thogether with coherent detection. In a hydrogen plasma ion temperatures and ion composition were determined with additives of different atomic mass.

8833 (IPF—81-7) **Absorption of magnetoacoustic waves in high beta plasmas.** Moser, F.; Raeuchle, E.; Schueller, P.G. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1981. 14p. (CONF-810906—15). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750947.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

The oscillations of a radially inhomogeneous high-β plasma column are investigated experimentally and theoretically. The high-β plasma is produced by a theta pinch discharge. The waves are launched during the post implosion phase in the frequency range of about 1 MHz. The spatial distribution of the wave fields is determined and a high absorption is observed. The absorption of magnetoacoustic waves is an efficient mechanism to heat a plasma. It was investigated under various conditions in the past. In this paper we present theoretical and experimental investigations in the transition region from the collision dominated to the collisionless regime. In the theoretical treatment the linearised MHD-equations are used where viscous and resistive effects are included.

8834 **(IPF—81-8) Confinement and magnetoacoustic heating of a low density belt-pinch plasma.** Erckmann, V.; Mueller, G.; Schwoerer, K.; Singethan, J.; Thumm, M.; Wilelm, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1981. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750951.

From 10. European conference on controlled fusion and plasma physics and workshop on stellerators and workshop on plasma focus; Moscow, USSR (14 - 25 Sep 1981).

Toroidal high-β -equilibria (β = 20-50%) are investigated in a Belt-Pinch configuration. Operating in the low density regime (nsub(e) <= 10^{20} m^{-3}) at temperatures around 200 eV the ion gyroradius becomes comparable with the typical gradient length. Under these conditions enhanced energy losses are observed. Applying magnetoacoustic wave excitation efficient energy coupling to the low density plasma has been found. In the special case of first cyclotron harmonic a pronounced increase of plasma-β is obtained. The central β-value has been raised from 25 to 45%.

8835 **(IPF—81-9) Ion emission characteristics of plasma focus devices.** Bertalot, L.; Deutsch, R.; Herold, H.; Jaeger, U.; Mozer, A.; Sadowski, M.; Schmidt, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1981. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750950.

From 10. European conference on controlled fusion and plasma physics and workshop on stellerators and workshop on plasma focus; Moscow, USSR (14 - 25 Sep 1981).

The angular distribution of ion emission has been studied experimentally with CN films and compared with model calculations. Thomson spectrograms revealed deuterons of maximum energy Esub(m) up to 5 MeV and different impurities with Esub(m) (1.8 to 14 MeV) being proportional to the ion charge. The ions are emitted mostly in single bursts (FWHM <= 8 ns) and sometimes in multispike pulses.

8836 **(IPF—81-10) Numerical simulation of electrostatic waves in plasmas.** Erz, U. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Aug 1981. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82751048.

In this paper the propagation of electrostatic waves in plasmas and the non-linear interactions, which occur in the case of large wave amplitudes, are studied using a new numerical method for plasma simulation. This mathematical description is based on the Vlasov-model. Changes in the distribution-function are taken into account and thus plasma kinetic effects can be treated.

8837 **(IPF—81-11) Ion motion in the plasma focus.** Deutsch, R.; Jaeger, U. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1981. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750949.

The cyclotron radius of the fast ions in the plasma focus is of the order of the plasma radius. It is shown in the paper, that in this case the following specifical effects appear: 1. The ions are partially trapped in the plasma column. This trapping effect is characterized by a parameter which depends only from the electric current intensity and from the energy of the ions. 2. In the case of local isotropical velocity distribution the azimuthal magnetic field leads to an average drift of the ions in the direction of the electric current. 3. The azimuthal magnetic field has a focusing effect on the ions. This effect leads to the appearance of density inhomogeneities, if some constrictions in the plasma column exist. 4. In the presence of the constrictions a supplimentary trapping of the ions by the inhomogeneities of the magnetic field appears. This leads to very pronounced peaks of the ion density in some regions of the focus-plasma. The theoretical results are able to explain the experimental results concerning the ion-pinhole-pictures and the ion-angular distribution measurements.

8838 **(IPF—81-12) Spectroscopic studies of impurities in the belt pinch HECTOR.** Singethan, J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Apr 1981. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82751047.

In this paper UV-line-intensity measurements of impurities are presented, which have been performed in the belt-pinch HECTOR. From the line-intensities impurity concentrations and information on the radiation losses is be obtained. At temperatures below 100 eV, the energy loss due to line emission of oxygen and carbon impurities is one of the most important electron energy loss mechanisms. Thus the measurement and calculation of the radiation losses is of particular relevance. Furthermore the electron temperature time dependence can be obtained by comparing the line intensity time dependence with the solution of the respective rate equations.

8839 **(IPF—81-13) First 50 pps Thomson scattering diagnostics in a tokamak.** Roehr, H.; Schramm, G.; Steuer, K.H.; Hirsch, K.; Salzmann, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1981. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750948.

Electron temperature and density measurements by Thomson scattering were performed for the first time for the whole duration of a tokamak discharge. A 50 pps Nd:YAG laser at 1.06 μm was used in ASDEX in combination with Si avalanche photodiode detectors. Density calibration was done by rotational anti-Stokes Raman scattering from hydrogen. The system is used for measurements at electron densities of as low as 2 x 10^{13} cm^{-3}.

8840 **(IPP—6/210) Extended standard vector analysis for plasma physics.** Wimmel, H.K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1982. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750706.

Standard vector analysis in 3-dimensional space, as found in most tables and textbooks, is complemented by a number of basic formulas that seem to be largely unknown, but are important in themselves and for some plasma physics applications, as is shown by several examples.

8841 **(Juel—1746) Application of linear programming to impurity flux evaluations.** Demokan, N.; Demokan, O.; Waelbroeck, F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). Nov 1981. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82750732.

An application of the Linear programming to the evaluation of impurity flux is demonstrated, in an attempt to obtain more conclusive information on the impurity transport mechansim. This gives a better insight to the accuracy required in the rate coefficients and in the experimental profiles, if clearcut information concerning the diffusion rates is to be obtained from the quasi-steady impurity profiles in tokamak plasmas. The behavior of Fe XXIII in PLT is taken as an example. A set of 'optimum' values for the rate coefficients, are computed. The density profiles of Fe XXIII are then evaluated from the continuity equation, using these 'optimum' values of rate coefficients, the experimental profiles of Fe XXII and Fe XXIV and assuming that the transport mechanism is purely neoclassical.

8842 **(NRL-MR—4893) Measurements of laser coupling and plasma profiles in longer-scalelength plasmas.** Herbst, M.J.; Burkhalter, P.G.; Grun, J.; Obenschain, S.P.; Stamper, J.A.; Young, F.C.; McLean, E.A.; Ripin, B.H.; Whitlock, R.R. (Naval Research Lab., Washington, DC (USA)). 30 Sep 1982. Contract AI08-79DP40092. 23p. (CONF-820553—3). NTIS, PC A02/MF A01. Order Number DE83002294.

From 12. anomalous absorption conference; Santa Fe, NM, USA (10 May 1982).

Novel configuration of our two-beam laser allows laser-coupling experiments to be performed in longer-scalelength plasmas (L/sub n/ $\simeq$ 250 to 600 μm at n/sub c/10), which better simulate reactor-sized pellet plasmas. Preliminary observations show increased backscatter, as expected, but also reveal large reductions in $2\omega_0$ and high-energy x-ray emissions. The latter may indicate lessened importance of resonance absorption in longer-scalelength plasmas. Measurements of plasma profiles are at least as important as coupling measurements in these experiments and we show new diagnostic techniques based upon tracer-dot methods. These include

the first techniques available for velocity profile measurement, as well as an improved x-ray spectroscopic method for density and temperature profile measurement.

8843 **(ORNL—5922) Atomic and ionic spectrum lines below 2000A: hydrogen through argon.** Kelly, R.L. (Oak Ridge National Lab., TN (USA)). Oct 1982. Contract W-7405-ENG-26. 408p. NTIS, PC A18/MF A01. Order Number DE83002582.

A critical tabulation of observed spectral lines below 2000 angstroms has been prepared from the published literature up to July 1978. It is intended principally as an aid to those physicists and astronomers who deal with the spectra of highly stripped atoms. This report includes the first 18 elements, from hydrogen (including deuterium) through argon. The tabulation is divided into two main sections: the spectrum lines by spectrum, and a finding list. The entries for each element give the ionization species, ground state term, and ionization potential, as well as the best values of vacuum wavelength, intensity, and classification. A list of the pertinent references is appended at the end.

8844 **(SAI—254-82-242-LJ) Particle exchange in the plug of a thermal-barrier tandem mirror.** Catto, P.J.; Carrera, R. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Oct 1982. Contract AC03-76ET53057. 22p. (PRI—48). NTIS, PC A02/MF A01. Order Number DE83002652.

The collisional fluxes of trapped electrons escaping from the plug and the center cell electrons passing over the thermal barrier and becoming trapped are evaluated for a simple thermal barrier model appropriate to present tandem mirror experiments.

8845 **(UCRL—87756) Fast pressure measurements for the TMX-U fusion experiment.** Hunt, A.L.; Coffield, F.E.; Pickles, W.L. (Lawrence Livermore National Lab., CA (USA)). 2 Nov 1982. Contract W-7405-ENG-48. 17p. (CONF-821111—13). NTIS, PC A02/MF A01. Order Number DE83002469.

From 29. national symposium on American Vacuum Society; Baltimore, MD, USA (16 Nov 1982).

The pressure on the boundary of the Lawrence Livermore National Laboratory's (LLNL) tandem mirror (TMX-U) plasma experiment is difficult to trace for several reasons: (1) the TMX-U boundary is in the high vacuum range (10^{-5} to 10^{-6} Pa) and requires an ionization gauge; (2) the boundary includes high-energy neutral particles and radiation, so the gauge must be optically baffled from the plasma; (3) the gauge must be shielded from the magnetic flux density of 0.03 T; (4) maximum conductance to the gauge must be preserved so that the time response remains about 1 ms; (5) a fast electrical circuit is required to measure the small ion-current changes at a rate consistent with the geometrical and experimental time constant of 1 ms. We have developed solutions to these limitations, including fast ionization gauge (FIG) circuitry for the remote gauge operation and the CAMAC system for recording the pressure-time history in the TMX-U computer data base. We also give some examples of actual fast pressure histories during plasma operation.

8846 **(UCRL—87766) Dynamic gas flow during plasma operation in TMX-U.** Pickles, W.L.; Carter, M.R.; Clower, C.A.; Drake, R.P.; Hunt, A.L.; Simonen, T.C.; Turner, W.C. (Lawrence Livermore National Lab., CA (USA)). 12 Nov 1982. Contract W-7405-ENG-48. 18p. (CONF-821111—14). NTIS, PC A02/MF A01. Order Number DE83000709.

From 29. national symposium on American Vacuum Society; Baltimore, MD, USA (16 Nov 1982).

Control of the neutral density outside of the plasma radius is essential for proper operation of the various plasma configurations in TMX-U. TMX-U excess-beam, stream-gun, gas-box, and beam-reflux gases are pumped internally in regions defined by 73° Ti-gettered liners and warm Ti-gettered plasma liners. The array of fast and slow ion gauges - a large TMX-U diagnostic - has been used to measure the dynamic pressure in many of the liner-defined regions on three time scales. The natural divertor action, or plasma pump effect, of mirror plasmas has been measured using the ion gauge diagnostics on a fast time scale during operation of TMX-U with ECRH start-up. Routine operation of TMX-U is enhanced by the ability to verify the effectiveness of gettering and to locate leaks using pressure data collected on the two slow time scales. A computer code, DYNAVAC 6, which treats TMX-U as a set of conductance-coupled regions with pumping and sources in each region, has been used to successfully model the overall gas dynamics during all phases of TMX-U operation.

8847 **(UCRL—87946) Flat-response x-ray-diode-detector development.** Tirsell, G. (Lawrence Livermore National Lab., CA (USA)). Oct 1982. Contract W-7405-ENG-48. 28p. (CONF-821128—1). NTIS, PC A03/MF A01. Order Number DE83001651.

From 24. American Physical Society annual meeting; New Orleans, LA, USA (1 Nov 1982).

In this report we discuss the design of an improved sub-nanosecond flat response x-ray diode detector needed for ICF diagnostics. This device consists of a high Z cathode and a complex filter tailored to flatten the response so that the total x-ray energy below 1.5 keV can be measured using a single detector. Three major problems have become evident as a result of our work with the original LLNL design including deviation from flatness due to a peak in the response below 200 eV, saturation at relatively low x-ray fluences, and long term gold cathode instability. We are investigating grazing incidence reflection to reduce the response below 200 eV, new high Z cathode materials for long term stability, and a new complex filter for improved flatness. Better saturation performance will require a modified XRD detector under development with reduced anode to cathode spacing and increased anode bias voltage.

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REFER ALSO TO CITATION(S) 7698, 7907, 7910, 7942, 7944, 7947, 7948, 7953, 7983, 7984, 8120, 8129, 8842, 8847

8848 **(DOE/ET/52040—266) Stability of high-beta tokamaks with respect to pellet injection.** Tetley, W.C. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1983. Contract AC02-76ET52040. 34p. (COO—2218-266). NTIS, PC A03/MF A01. Order Number DE83002912.

Thesis. Submitted to the Univ. of Illinois, Urbana-Champaign, IL.

During the course of a long pulse or steady state operation, the fuel in a plasma becomes depleted. This necessitates the refueling of the reactor. Several methods have been proposed. In this thesis the use of pellet injection in a high toroidal beta tokamak is explored. Specifically the effect on stability is studied. Limits on the beta are found with respect to the size of the pellet injected. The device studied is the proposed upgrade of the Doublet III. The principal conclusion is that the stable beta is dependent on the shape of the current profile, and that by flattening the profile the plasma stability is increased.

8849 (EUR—7425(Pt.1), pp 259-267) **Developments in microwave tubes for RF heating of plasmas.** Faillon, G.; Mourier, G. (Thomson-CSF, Paris (France)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Some technological problems concerning the klystron and the gyrotron are discussed. For klystrons, the more urgent questions are the multipactor effect, the efficiency, the band width, the RF output windows and the collector. For gyrotrons, frequency limits and wall losses, RF windows, the external circuits and the polarization of the field are presented.

8850 (EUR—7425(Pt.1), pp 269-282) **Pulsed and CW gyrotron oscillators of plasma heating.** Jory, H.; Evans, S.; Moran, J.; Shively, J.; Stone, D.; Thomas, G. (Varian Associates, Inc., California (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

This paper describes design and operation of pulsed and cw oscillators working at the 200 kW level at 28 GHz and the design of simular devices to be operated at 60 GHz.

8851 (EUR—7425(Pt.1), pp 485-507) **ICRH antenna design and coupling optimization studies.** Weynants, R.R.; Messiaen, A.M.; Leblud, C.; Vandenplas, P.E. (EURATOM-Etat Belge Association, Bruxelles (Belgium)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

A complete analysis of an ICRH antenna system is given yielding practical criteria for design optimisation relevant to large machines. After having analysed the screening effect of an electrostatic shield, a solution is presented for the field distribution around an electrostatically shielded antenna from which the effect of the plasma on the loading and the reactance of the antenna can be obtained. A general procedure for the application of these results to multple antennae system is outlined and practical rules are derived for optimizing the rf power unit antenna surface coupled to the plasma.

8852 (EUR—7425(Pt.1), pp 621-627) **Multi-megawatt radio frequency power source for plasma heating.** Sivo, A.J.; Greenough, N.L.; Lawson, J.Q.; Newman, W.G.; Shapiro, S.W. (Princeton University, New Jersey (USA)). 1981. Dep. NTIS (US Sales Only).

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

This paper describes the design, construction, and results of a 2.5 megawatt, 300 millisecond pulsed duration, radio frequency generator for use in the furtherance of Ion Cyclotron Resonance Heating experiments on the Princeton Large Torus (PLT) machine. With the proper selection of frequency determining parts, the rf generator is capable of operating within a frequency range of 42 to 58 megahertz.

8853 **(HEDL-SA—2715-FP) Track-mounted remote handling system for the Tokamak Fusion Engineering Test.** Kelly, V.P.; Berger, J.D.; Daubert, R.L.; Yount, J.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 1982. Contract AC06-76FF02170. 8p. (CONF-821103—30). NTIS, PC A02/MF A01. Order Number DE83003371.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

Portions of document are illegible.

Concepts for remote handling machines (IVM) designed to transverse the interior of toroidal vessels with guidance and support from track systems have been developed for the proposed Tokamak Fusion Engineering Test (TFET). TFET has been proposed as an upgrade for the Tokamak Fusion Test Reactor (TFTR), currently nearing completion. The track-mounted IVMs were conceived to perform in-vessel remote maintenance for TFET, including removal and replacement of pump limiter blades and protective tiles as well as other maintenance-related tasks such as vessel wall inspection leak testing and interior cleanup. The conceptual IVMs consist of three manipulator arms mounted on a common frame member: a single power manipulator arm with high load carrying capacity and two lower-capacity servomanipulator arms. Descriptions of the IVM concepts, in-vessel track systems, and ex-vessel handling systems are presented.

8854 **(HEDL-SA—2741-FP) Transport of ^{7}Be in a lithium loop.** Katsuta, H.; Anantatmula, R.P.; Bechtold, R.A.; Brehm, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1982. Contract AC06-76FF02170. 17p. (CONF-821103—31). NTIS, PC A02/MF A01. Order Number DE83002911.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

Beryllium-7 will be produced in the lithium target of the Fusion Materials Irradiation Test (FMIT) facility by the interaction of the deuteron beam with lithium by the two reactions ^{7}Li(d,2n)^{7}Be and ^{6}Li(d,n)^{7}Be. Recent estimates have shown that an equilibrium concentration of 45,000 curies of ^{7}Be will be present in FMIT lithium. Although this inventory of ^{7}Be corresponds to only 0.042 wt ppM in FMIT lithium, the radiation fields created can impose special design and maintenance requirements on the facility. A development program has been started at the Hanford Engineering Development Laboratory (HEDL) to investigate the transport of ^{7}Be in liquid lithium. Results obtained thus far indicated preferential deposition of ^{7}Be not only in the cold leg but also in the higher temperature region in a nonisothermal lithium system with a temperature gradient similar to that expected in FMIT. The results showed that ^{7}Be can diffuse into AISI 304 stainless steel (304) at FMIT operating temperatures; the diffusion coefficient of ^{7}Be in 304 was also calculated.

8855 **(IPP—1/187) Refuelling of plasma machines by pellet injection with a centrifuge.** Amenda, W.; Lang, R.S. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1981. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750448.

In refuelling plasma machines with large plasma diameter and high density and temperature the gas intake is likely to be insufficient. This applies particularly to plasma machines operated with divertor. Great importance is thus attached to refuelling by injection of frozen hydrogen pellets. It is also hoped that the plasma parameters can be influenced by pellet injection. Till now pneumatic pellet injectors and centrifuges have been used to attain pellet velocities above 200 m/s. This paper affords an insight into the present performance of pellet injection by centrifuge. Besides the rotor material and geometry, the shape of the accelerating channel and its significance in relation to the forced acceleration of pellets is also treated. The problem of preparing solid hydrogen and introducing it into the accelerating channel and the influence of this on the exit scatter of pellets are discussed. The peripheral equipment required for centrifugal acceleration, such as pellet diagnostics, pellet beam tube into the plasma, and control synchronization facilities, are briefly touched on.

8856 **(IPP—1/189) Diffusion of the vertical field into the tape-wound magnet.** Gottardi, N.; Mast, F.; Preis, H.; Suess, R. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1981. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750374.

A computer program was developed to calculate eddy currents in electrically conducting structures of general geometry in order to determine their magnetic fields. The program is based on the finite element network method (FEN), in which the structure considered is divided into directed, finite elements. Each element is then treated as a branch of a three-dimensional RL network. After R and L in all of the network branches have been calculated, the network differential equations represented in matrix form is solved. The time behaviour and distribution of the eddy currents then follow directly from the solution vector of the transient branch currents. The FEN is tested in the case of vertical field diffusion through the toroidal field coils of ZEPHYR. For this purpose an electrical model of the coil configurations was constructed on a scale of 1:5. The scaling laws applied are described. A detailed description of the measuring method used is given. The results of the calculations and measurements are compared for various frequencies of the vertical field.

8857 **(IPP—1/196) Technical specification of a tokamak poloidalfield-coil-system (ZEPHYR) with special consideration of the central (OH) coil within a magnetic field of extremely high value (27 T).** Harmeyer, E.; Kollotzek, H.; Pillsticker, M.; Wanner, W.; Werner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1981. 147p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82750731.

The plant conditions giving the poloidal magnetic field required bring about extremly high loads and stresses within the coils, especially within the central OH transformer coil. The maximum magnetic field of nearly 27 T arises if the central OH coil is excited with a current of 9.1 KA/cm^{2}. The pulsating load of the coils intended with pulses of 10 s duration produces a rise in temperature of $\Delta T > 120$ K meaning that the start temperature has to be less than 80 K. The time between the current pulses used for cooling down the coils to their start temperature should be passed within a

limit of 0.5 h. The report gives a detailed statement of the central OH coil and a proposal for manufacturing and working it.

8858 (IPP—1/197) ASDEX upgrade - definition of a tokamak experiment with a reactor compatible polaoidal divertor. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1982. 120p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750701.

ASDEX Upgrade is intended as the next experimental step after ASDEX. It is designed to investigate the physics of a divertor tokamak as closely as possible to fusion reactor requirements, without thermonuclear heating. It is characterized by a poloidal divertor configuration with divertor coils located outside the toroidal field coils, by machine parameters which allow a line density within the plasma boundary sufficient to screen fast CX particles from the plasma core, by a scrape-off layer essentially opaque to neutrals produced at the target plates, and, finally, by an auxiliary heating power high enough for producing a reactor-like power flux density through the plasma boundary. Design considerations on the basis of physical and technical constraints yielded the tokamak system optimized with respect to effort and costs as described in the following. It uses normal-conducting coil systems, is the size of ASDEX, and has a field of 3.9 T, a plasma current of up to 1.5 MA, and a pulse duration of 10 s. To provide the required power flux density, an ICRH power of 10 MW is needed. For comparison, a superconducting version is under investigation.

8859 (IPP—1/201) ZEPHYR - poloidal field system. Seidel, U. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1982. 71p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750973.

The basics of the poloidal field system of the ZEPHYR experiment are considered. From the physical data the requirements for the poloidal field are derived. Hence an appropriate coil configuration consisting of coil locations and corresponding currents is obtained. A suitable electrical circuit feeding the coils is described. A preliminary assessment of the dynamic control of the poloidal field system is given.

8860 (IPP—III/65) Equipment protection and safety system for the ASDEX tokamak. Gernhardt, J.; Groening, D.; Hohenoecker, H.; Ruhs, N. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1981. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750450.

Our compromise between safety requirements and costs is a hybrid of relay, solid-state and computer-controlled protection systems used for ASDEX. The toroidal field coils, ohmic heating coils, vertical field coils, divertor coils, radial field coils, stainless-steel vacuum vessel and structure are protected by measuring the water flow (131 channels), temperature (142 channels), mechanical displacements (141 channels), voltage symmetry (28 channels), current symmetry (6 channels), weight of the vessel (8 channels) and the overvoltage. To detect flow, temperature, displacement, voltage, current and weight, we use the following devices: Venturi tubes (self-made), RTD thermoresistors (Pt-100), linear potentiometers (1 kΩ), voltage dividers (self-made), Rogowski coils (self-made) and straing gauges.

8861 (IPP-III—73) Divertor experiments in ASDEX. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1981. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750707.

A collection of papers presented at the IAEA Technical Committee Meeting on Divertors and Impurity Control, 6-10 July 1981, Garching, FRG (to be published in the proceedings of this conference, edited by M. Keilhacker and U. Daybelge).

8862 (Juel—1727) Calculation of the possible tritium production in irradiation positions of the FRJ-2(DIDO) for fusion blanket experiments. Krug, W.; Weise, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Brennelement- und Bestrahlungstechnologie). Jul 1981. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82750449.

In the field of tritium and fusion blanket technology possibly an important and early contribution to the development of a fusion reactor blanket can be obtained by irradiation experiments at the research reactor FRJ-2 in Juelich, Federal Republic of Germany. However, the tritium production rate of 0.2 x 10^{13} to 2 x 10^{13} $cm^{-3}s^{-1}$ and the power per volume of 2 to 20 W cm^{-3} characteristic for a fusion reactor blanket have to be realized. The present report shows the reachable tritium values calculated for different irradiation positions in the FRJ-2 for natural lithium as a breeder material considering the actual existing neutron spectrum. Based on these results we come to the conclusion that the specified blanket data can actually be reached and adjusted. Therefore irradiation experiments at the FRJ-2 would be able to supply basical results for the fusion blanket development.

8863 (KFK—3202/2) HIBALL - a conceptual heavy ion beam driven fusion reactor study. Vol. 2. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Dec 1981. 361p. (UWFDM—450). NTIS (US Sales Only), PC A16/MF A01. Order Number DE82750733.

A preliminary concept for a heavy-ion beam driven inertial confinement fusion power plant is presented. The high repetition rate of the RF accelerator driver is utilized to serve four reactor chambers alternatingly. In the chambers a novel first-wall protection scheme is used. At a target gain of 83 the total net electrical output is 3.8 GW. The recirculating power fraction is below 15%. The main goal of the comprehensive HIBALL study (which is continuing) is to demonstrate the compatibility of the design of the driver, the target and the reactor chambers. Though preliminary, the present design is essentially self-consistent. Tentative cost estimates are given. The costs compare well with those found in similar studies on other types of fusion reactors.

8864 (KFK—3252) Numerical calculations of an effective elasticity tensor and extremal stresses for arbitrary magnet composites. Iwanicki, T. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Mar 1982. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82750686.

For the calculation of mechanical properties of large magnet systems in 3-dimensional space, a very fine subdivision of the magnetstructure is necessary. In the finite element programms, this will lead to unacceptably long computing times and to the limits of computer-storage capacity. This limitation requires a simplification of the structure model. The objective of this work is to find such simplifications that yield still reliable results by the stress-strain analysis. This problem can be solved by the numerical method, called 'numerical simulation', by which an effective elasticity tensor will be obtained for a composite material. The structure can be arbitrarily complicated and may contain voids, e.g. cooling channels, which are weak elements for the structural analysis. The structure has to perform only a homogeneity-condition, i.e. it must be possible to define a 'representative volume element' (RVE). With the effective elasticity tensor, which can be found for such RVE, it is possible to calculate the average stress and with the surface displacement method also the extremal stresses in each point of the structure. It is found a good agreement between experimental and theoretical moduli of elasticity.

8865 (KMSF-U—1245) Software migration from RSX to VMS: programming for transportability. Downward, J.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1982. Contract AC08-82DP40152. 13p. (CONF-821201—2). NTIS, PC A02/MF A01. Order Number DE83002542.

From Fall DECUS US Symposium; Anaheim, CA, USA (6 Dec 1982).

New users of VAX/VMS are often faced with migrating applications written for RSX11M into the VAX/VMS environment. Generally, applications written in a high level language can be migrated without too many changes, but the effort is complicated by the intrinsic differences in executive services between the two systems, and by differences in the behavior of the language compilers. The migration effort can be simplified by: (1) writing code using language features which work identically on both systems; (2) isolating operating system dependent features in system dependent

subroutines; and (3) providing a set of executive service subroutine calls for use on both systems. These techniques have the advantage of producing code which is transportable between RSX and VMS systems.

8866 **(LBL—14317) Effect of capacitive stored energy on neutral-beam-accelerator performance.** Owren, H.M.; Baker, W.R.; Berkner, K.H.; Hopkins, D.B.; Massoletti, D.J. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 6p. (CONF-820948—5). NTIS, PC A02/MF A01. Order Number DE83002329.

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

The results of tests to determine the effects of capacitive stored energy (1/2 CV^2) on the performance of neutral-beam injectors are reported. Typical fault-current waveforms and methods to limit fault current are presented. Tests indicate that deterioration of performance is not only a function of peak stored energy but is also dependent on peak current and the characteristics of the breakdown.

8867 **(LBL—14631) Calculations of gas density in a closely-packed multi-channel electrostatic quadrupole (MESQ) array.** Burrell, C.F.; Goldberg, D.A. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 9p. (CONF-821111—12). NTIS, PC A02/MF A01. Order Number DE83002233.

From 29. national symposium on American Vacuum Society; Baltimore, MD, USA (16 Nov 1982).

As a part of our program for developing new accelerators for high-energy negative ion neutral beamlines, we have studied the pumping properties of a MESQ array such as might be interposed between the ion-source/pre-accelerator and a MESQ accelerator. The studies were performed using a two-and-a-half dimensional Monte Carlo code under the assumption of molecular flow, with pumping to be provided by cryopanels on either side of the array. The basic unit treated by the code was a unit cell which could be translated laterally or longitudinally to reproduce the full array. We have studied the behavior of the system as a function of electrode geometry, array size, and cryopanel position. It was found necessary to insert lateral baffles periodically to prevent downstream migration of the gas in the region between the outer edge of the MESQ array and the cryopanels.

8868 **(NRL-MR—4915) Effects of partial suppression of ion emission in moderate-impedance diodes.** Barker, R.J.; Goldstein, S.A. (JAYCOR, Alexandria, VA (USA); Naval Research Lab., Washington, DC (USA)). 30 Sep 1982. Contract AI01-77DP40042. 32p. NTIS, PC A03/MF A01. Order Number DE83002955.

Numerical simulations have been completed testing the effects of partial ion emission suppression in 4 to 5 OMEGA pulsed power diodes. They were conducted to obtain physical insight into the results of a series of parallel experiments conducted on the Gamble II machine at NRL. A standard axial diode with a 3.0 cm outer radius hollow cathode and an electron reflexing anode foil was found to operate at 1.8 MV and 4.8 OMEGA with an effective ion efficiency of 0.32. Suppressing ion emission along the anode foil beyond a radius equal to the inner radius of the hollow cathode raised the diode impedance at the same voltage to 6.7 OMEGA and lowered the effective ion efficiency to 0.29. Decreasing the anode-cathode (A-K) gap from 5.0 mm to 3.5 mm and retaining the same degree of ion emission suppression lowered the impedance again in 4.8 OMEGA and returned the effective ion efficiency again to 0.32. That efficiency is in good agreement with the experimental findings for the same 3.5-mm gap case but is 0.03-0.07 higher than that experimentally observed for the 5.0-mm gap without ion emission suppression. The discrepancy may be actual or it may be due to a return electron current which masks some of the experimentally observed ion current for that case.

8869 **(ORNL/Sub—81-21099/1-03) Elmo Bumpy Torus proof of principle. Phase II. Title 1 report. Volume III. Magnet system. Preliminary design report.** Ackerman, S. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). 26 Feb 1982. Contract W-7405-ENG-26. 791p. NTIS, PC A99/MF A01. Order Number DE83002550.

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During Title I, General Dynamics' principal role as a subcontractor to the McDonnell Douglas Astronautics Company (MDAC) is to assist in the further development of a low-cost superconducting magnet mirror coil system for the EBT-P program consistent with long life and dependable operation. The activity can best be defined as an extension of ORNL's previous development program with further joint ORNL/MDAC/GDC refining of the mirror coil components. MDAC/GDC participation for the entire program can be subdivided into four distinct elements as follows: (1) design, development, and fabrication of two dewar subassemblies to enclose the ORNL developed and fabricated cold mass assemblies; (2) design, development, and fabrication of a production prototype magnet system including conductor (procurement), cold mass components, dewar and x-ray shield. This prototype would form the basis for the production of 36 magnets for the torus and three spares. (3) design, development, and fabrication of an electrical/electronic system including quench protection, instrumentation and control, and power supply to power and protect the mirror coil system during its operation in the torus; (4) fabrication of the 39 production magnets.

8870 **(PPPL—1938) Long-time correlations in the stochastic regime.** Karney, C.F.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1982. Contract AC02-76CH03073. 40p. NTIS, PC A03/MF A01. Order Number DE83002944.

The phase space for Hamiltonians of two degrees of freedom is usually divided into stochastic and integrable components. Even when well into the stochastic regime, integrable orbits may surround small stable regions or islands. The effect of these islands on the correlation function for the stochastic trajectories is examined. Depending on the value of the parameter describing the rotation number for the elliptic fixed point at the center of the island, the long-time correlation function may decay as t^{-5} or exponentially, but more commonly it decays much more slowly (roughly as t^{-1}). As a consequence these small islands may have a profound effect on the properties such as the diffusion coefficient, of the stochastic orbits.

8871 **(PPPL—1953) Numerical treatment of the axial singularity in a flux-coordinate system.** Kuo-Petravic, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1982. Contract AC02-76CH03073. 9p. NTIS, PC A02/MF A01. Order Number DE83002943.

In the realistic simulation of physical systems whether in 2-D or 3-D there arise often situations where the fluid flow has a preferred direction. An example of this is a magnetically confined plasma where the flow is predominently along the magnetic field lines. To avoid a large numerical diffusion and hence inaccuracy, it is often necessary to adopt a flux coordinate system with coordinates following closely the contours given naturally by the physics of the problem, an example for this is shown.

8872 **(SAND—82-0304) Analytic theory of series-field-coil ion diodes.** Mendel, C.W. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1982. Contract AC04-76DP00789. 53p. NTIS, PC A04/MF A01. Order Number DE83002630.

Ion diodes suited to inertially confined fusion research conduct very high currents. The magnetic fields due to these currents are comparable to the fields used to provide magnetic insulation of electrons. Because these self-fields are necessarily high at the diode boundary where the power is applied, and are zero at some other part of the diode away from the power feed, these diodes have generally been treated theoretically by two-dimensional particle-in-cell computer simulations. We have found a special class of ion diodes employing series magnetic field coils which can be described by a one-dimensional model. These diodes are highly amenable to treatment by analytic theory, and therefore are easily designed and scaled to multiterrawatt systems. Many features of these diodes make them very attractive as drivers for inertial confinement fusion research. Theoretical analysis of this class, including magnetic field configuration and field coil design, electron drifts, diode efficiency, and ion focusing is presented. Also presented is analysis of plasma filled version which provides ion bunching and filtering of light ion

species which might otherwise have detrimental effects on target experiments.

8873 **(SAND—82-1141C) Recovery of electron-sheath current in magnetically self-insulated transmission lines.** Crow, J.T.; Peterson, G.D. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 12p. (CONF-821024—7). NTIS, PC A02/MF A01. Order Number DE83002148.

From 10. international symposium on discharges and electrical insulation in vacuum; Columbia, SC, USA (25 Oct 1982).

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Magnetically self-insulated lines operating at high electric field stress have a high percentage of the current flow in an electron sheath adjacent to the cathode. Recovery of the current in this sheath is desirable for efficient power transport. The Sandia National Laboratories HydraMITE accelerator has a magnetically insulated transmission line which has a 7.6 Ω geometric impedance, and operates at 4.8 Ω, indicating that approximately 40% of the current flows in the electron sheath. An experiment was conducted on the HydraMITE machine in which input and output currents were measured on a section of line which the impedance changed smoothly from 7.6 Ω to 20 Ω. Measurements were made with a range of inductive and resistive loads. The input and output currents were then compared to lumped circuit line simulations to separate losses related to inductance from electron sheath losses.

8874 **(SAND—82-1560C) Trapping and surface recombination of deuterium in fusion-reactor metals.** Myers, S.M. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 8p. (CONF-821123—9). NTIS, PC A02/MF A01. Order Number DE83002147.

From 7. conference on the application of accelerators in research and industry; Denton, TX, USA (8 Nov 1982).

Ion implantation and ion beam analysis were used to examine bulk trapping and surface recombination for deuterium in Fe, Ni, and austenitic stainless steel. Irradiation-defect traps were characterized in the three metals, and substantially stronger traps were shown to be associated with small He bubbles. The rate of deuterium release at stainless-steel and Fe surfaces was measured as a function of temperature and solution concentration. Trapping and surface recombination parameters were extracted by applying established theory for solute diffusion within a field of traps.

8875 **(SAND—82-2028C) Advances in ICF using light-ion beams.** Yonas, G.; VanDevender, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 20p. (CONF-821089—1). NTIS, PC A02/MF A01. Order Number DE83002186.

From 6. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (25 Oct 1982).

PBFA II, with parameters of 3.5 MJ and 100 TW, is being designed to allow inertial fusion ignition experiments using imploding foils or light ion beams. Imploding foil data on Proto II have demonstrated that electromagnetic energy can be efficiently converted into foil kinetic energy with the output increasing as the square of the foil current. Our experiments have reached 60 kJ at 5 MA with the foil imploding in 80 ns and stagneting in 10 ns. One-TW proton diodes have delivered ~ 2 TW/cm^2 to 3-mm-diam targets using ballistic focusing that is limited by beam divergences of typically 20 mrad. The intrinsic divergence is induced by instabilities in the electron-ion flow, nonuniformities in the anode plasma, or a combination of these effects. Further increases in intensity can be achieved with increases in voltage and ion mass, as well as with beam bunching.

8876 **(UCRL—15507) Conceptual capital-cost estimate and facility design of the Mirror-Fusion Technology Demonstration Facility.** (Bechtel Group, Inc., San Francisco, CA (USA)). Sep 1982. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01. Order Number DE83002278.

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This report contains contributions by Bechtel Group, Inc. to Lawrence Livermore National Laboratory (LLNL) for the final report on the conceptual design of the Mirror Fusion Technology Demonstration Facility (TDF). Included in this report are the following contributions: (1) conceptual capital cost estimate, (2) structural design, and (3) plot plan and plant arrangement drawings. The conceptual capital cost estimate is prepared in a format suitable for inclusion as a section in the TDF final report. The structural design and drawings are prepared as partial inputs to the TDF final report section on facilities design, which is being prepared by the FEDC.

8877 **(UCRL—50021-80-Vol.1) Laser program annual report, 1980.** Coleman, L.W.; Krupke, W.F.; Strack, J.R. (eds.). (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 386p. NTIS, PC A17/MF A01. Order Number DE83002429.

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Volume 1 provides a Program Overview, presenting highlights of the technical accomplishments of the elements of the Program, a summary of activities carried out under the Glass Laser Experiments Lead Laboratory Program, as well as discussions of Program resources and facilities. Section 2, also in the first volume, covers the work on solid state Nd:glass lasers, including systems operations, Nova and Novette system development, and supporting research and development activities.

8878 **(UCRL—50021-80-Vol.2) Laser program annual report, 1980.** Coleman, L.W.; Krupke, W.F.; Strack, J.R. (eds.). (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 374p. NTIS, PC A16/MF A01. Order Number DE83002430.

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Volume 2 contains five sections that cover the areas of target design, target fabrication, diagnostics, and fusion experiments. Section 3 reports on target design activities, plasma theory and simulation, code development, and atomic theory. Section 4 presents the accomplishments of the Target Fabrication Group, Section 5 contains the results of our diagnostics development, and Section 6 describes advances made in the management and analysis of experimental data. Finally, Section 7 in Volume 2 reports the results of laser target experiments conducted during the year.

8879 **(UCRL—50021-80-Vol.3) Laser program annual report, 1980.** Coleman, L.W.; Krupke, W.F.; Strack, J.R. (eds.). (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 270p. NTIS, PC A12/MF A01. Order Number DE83002431.

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Volume 3 is comprised of three sections, beginning with Section 8 on Advanced Lasers. Both theoretical and experimental research and development activities on advanced laser systems are presented here. Section 9 contains the results of studies in areas of energy and military applications, including those relating to electrical energy production by inertial confinement fusion systems. Finally, Section 10 presents results from selected activities in the Advanced Isotope Separation Program.

8880 **(UCRL—87732) Continuous cryopump for steady-state Mirror Fusion Reactors.** Batzer, T.H.; Call, W.R. (Lawrence Livermore National Lab., CA (USA)). 20 Sep 1982. Contract W-7405-ENG-48. 17p. (CONF-821111—10). NTIS, PC A02/MF A01. Order Number DE83001497.

From 29. national symposium on American Vacuum Society; Baltimore, MD, USA (16 Nov 1982).

The characteristics of Mirror Fusion Reactors, i.e., steady state operation, a low neutral gas density and a large gas throughput require unique vacuum pumping capabilities. One approach that appears to meet these requirements is a liquid helium cooled cryopump system in which a fixed portion can be isolated and degassed while the remainder continues to pump. The time to degas a rotating, fixed portion of the pumping area and the ratio of that area to the total area fixes the gas inventory in the chamber. It follows that the active pump area maintains the required neutral gas density and the time averaged degassing rate equals the gas throughput. We have built such a cryopump whereby the gas condensed (deuterium) on the liquid helium cooled panel can be transferred to a collector pump and subsequently to an exterior mechanical pump and exhausted. At panel loadings as high as .55 torr-litres/cm^2 the gas leakage during degassing is less than 8% and the degassing time is less than 10 minutes. Scaling to reactor size appears to be feasible.

8881 **(UCRL—87831) Multi-megawatt neutral beams for MFTF-B.** Kerr, R.G. (Lawrence Livermore National Lab., CA (USA)). 8 Nov 1982. Contract W-7405-ENG-48. 5p. (CONF-821123—10). NTIS, PC A02/MF A01. Order Number DE83003375.

From 7. conference on the application of accelerators in research and industry; Denton, TX, USA (8 Nov 1982).

Multi-megawatt neutral-beam sources have successfully made the transition from prototype to commercial production, with some operational improvements due to the commercialization. Long pulse source operation results will be available soon.

8882 **Heat transport system.** Harkness, S.D. (to Dept. of Energy). US Patent 4,343,761. 10 Aug 1982. Filed date 16 Nov 1979. vp.

PAT-APPL-094993.

A falling bed of ceramic particles receives neutron irradiation from a neutron-producing plasma and thereby transports energy as heat from the plasma to a heat exchange location where the ceramic particles are cooled by a gas flow. The cooled ceramic particles are elevated to a location from which they may again pass by gravity through the region where they are exposed to neutron radiation. Ceramic particles of alumina, magnesia, silica and combinations of these materials are contemplated as hightemperature materials that will accept energy from neutron irradiation. Separate containers of material incorporating lithium are exposed to the neutron flux for the breeding of tritium that may subsequently be used in neutron-producing reactions. The falling bed of ceramic particles includes velocity partitioning between compartments near to the neutron-producing plasma and compartments away from the plasma to moderate the maximum temperature in the bed.

8883 **Design and operation of a time-gated optical system for measuring the angular distribution of light emitted from laser targets.** Miller, L.W.; Kruse, H.W.; Kruse, P.J.; Bartram, D.E.; Hoffman, N.M.; Mack, J.M. (Los Alamos Scientific Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **190**: 430-437(1979).

We describe an optical system which produces two simultaneous, time-gated, magnified images of the back-side of a planar laser target. The two views of the target are from different directions relative to the target normal but may be chosen to be at the same angle relative to the direction of incidence of the laser beam so as to permit cancellation of any angular correlation relative to the laser beam direction. The two images are amplified by a time-gated channelplate intensifier (CPI) and recorded on 35 mm film. This device permits measurement of the angular distribution relative to the target normal of light emitted from the back-side of laser targets as a function of time relative to the start of the laser pulse; such measurements are required in an experiment described in the report, The Limb-Darkening Opacity Experiment Using a Laser-Heated Plasma, LA-7484-MS. We describe the operation of the device and discuss an important instrumental effect due to non-simultaneous gating of different portions of the CPI tube whereby an incorrect angular distribution can be obtained. We discuss precautions necessary to insure that this does not occur. Samples of data will be presented.

99 GENERAL AND MISCELLANEOUS

9901 Management

8884 **(EGG-TPUB—6081) Pilot study of possible benefits of office automation to EG & G Idaho, Inc.** Jenkins, W.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1982. Contract AC07-76ID01570. 178p. NTIS, PC A09/MF A01. Order Number DE83002515.

Portions of document are illegible.

A small pilot project was conducted at EG & G Idaho, Inc., to discover whether the application of current automated office technology could significantly reduce administrative costs. The project was conducted by a nine-member EG & G task force. Most of the major equipment for the project was already owned by EG & G and was manufactured by a single computer vendor, the Four-Phase Corporation; although there were several other suitable hardware suppliers, the choice of Four-Phase was based primarily on the economics of immediate availability. Requirements for an automated office system (AOS) were developed through interviews with a cross section of typical Company users. (AOS functions were divided into two categories: word-processing and office applications.) Text-processing software from Four-Phase was used without modification. Their office-applications distributed-processing software was used to support nine data-processing applications written by our in-house programmers in Four-Phase format code: four applications were patterned after the vendor's office-management software; five applications were written entirely by our programmers. The AOS test was conducted using a vertically structured experimental group and a like control group, all within the domain of a single Associate General Manager (equivalent of a vice president). An outside consulting firm was hired to assist in designing the data-gathering and -measuring system. (A Company-wide test involving networking and telecommunications functions was precluded by the limited size of the pilot project.) The pilot project demonstrated that significant savings can be realized through the use of current automated office technology. The study showed that the greatest benefits are obtained at the higher organizational levels and that the system must be installed only in manager/secretary combinations.

8885 **(NP—2906256) Engler-Bunte Institute of Karlsruhe University (TH).** Hedden, K.; Griesbaum, K.; Leuckel, W. (Karlsruhe Univ. (TH) (Germany, F.R.). Engler-Bunte Inst.). Apr 1981. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82906256.

The annual report 1980 informs on the research activities (publications, conference papers, training activities and lectures, current research work) of the 4 divisions of the Engler-Bunte-Institute of Karlsruhe University: 1) Gas, petroleum, coal; 2) petrochemistry; 3) combustion engineering and 4) water chemistry.

8886 **(NP—2906277) Report on the business year 1980.** (Technische Werke der Stadt Stuttgart A.G. (Germany, F.R.)). [nd]. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906277.

The fields of activity of TWS (Stuttgart Technical Utilities) include the supply of electricity, gas, water and district heat (coordinated supply network) and the realization of tasks in the field of telecommunication of the city of Stuttgart. The introduction of the present annual report presents some general remarks on the total economy and the energy market. A report follows on the structure and activities of this public utility in its different branches. Furthermore, explanations are given on the annual statement of accounts of 1980, and the report of the Board of Directors is mentioned. Enclosures of the annual balance and of the profit and loss account are added.

8887 **(NP—3900246) Analysis and planning of the environment by distributing decisions.** Wirth, W. (Augsburg Univ. (Germany, F.R.). Fakultaet fuer Wirtschafts- und Sozialwissenschaft). 15 Dec 1980. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83900246.

Thesis.

The article at first analyses theoretical and empiric research bases concerning enterprises. A complete presentation of this investigation cannot be given. The main concern is rather to find the aspects thought relevant for the development of an own conceptualisation to understand the environmental conditions and then to prepare a concept of understanding on the basis of the existing knowledge. The approach used here to operationalise the environment of enterprises is related to the environment of tasks as a sphere of direct exchange relations which has a direct relation to the setting and achieving of goals in enterprises. To empirically understand this environmental sphere, indicators are formed which are to show the external dependence deriving from the exchange relations of resources and performance and the environmental dynamics of the enterprise. The evaluation of the data determined using these indicators is to provide a general view at the environmental conditions existing at the time of the questionnaire pointing out environmental characteristics important for large industrial enterprises.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 7434, 8760, 8773, 8884

8888 (ANL—82-45) Methodology for algorithm development through schema transformations. Muralidharan, M.N. (Argonne National Lab., IL (USA)). Jul 1982. Contract W-31-109-ENG-38. 79p. NTIS, PC A05/MF A01. Order Number DE83003342.

A programming methodology based on schema transformations is presented. Such an approach is a logical outcome of recent developments in program manipulating systems. Concurrent development of algorithms and thir proofs of correctness is a significant feature of the proposed methodology. As the development process begins with an abstract schema, it is often possible to derive several related end algorithms in a single development process. This has implications in both the economics of software development and the understanding and teaching of algorithms. The initial schematic specification (a skeleton algorithm schema), the intermediate and final algorithm schemata are all expressed in Darlington's first-order recursion equation language exploiting set-theoretic constructs. A set of transformation rules together with a set of reduction rules for set expressions is then used to successively transform the schematic specification into different algorithm schemata. Most of the transformations are applications of a small number of common rewriting rules.

8889 (BMFT-FB-T—81-215) Development of a data logging and transmission unit. Vogg, R.; Wiedemann, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1981. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82750375.

The data logging and transmission unit is a data collection device with an intersection for long-distance transmission of the collected data to a superior central station. The execution of hardware and software was done under consideration of the special operation conditions in environment measuring engineering.

8890 (IKF—41, pp 95) **Progress at the computer codes Walkuere, Walhalla, Parzival, and Ysupp for multiple Coulomb excitation.** Ower, H. 1982. (In German). NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8891 (IPEN-Inf—05) ANACROM - A computer code for chromatogram analysis. Gouveia, A.S. de; Mesquita, C.H. de. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jan 1981. 40p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82703397.

The computer code was developed for automatic research of peaks and evaluation of chromatogram parameters as : center, height, area, medium - height width (FWHM) and the rate FWHM/center of each peak.

8892 (IPEN-Inf—07) Compilation of the abstracts of nuclear computer codes available at CPD/IPEN. Granzotto, A.; Gouveia, A.S. de; Lourencao, E.M. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jun 1981. 93p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82703398.

A compilation of all computer codes available at IPEN in S.Paulo are presented. These computer codes are classified according to Argonne National Laboratory - and Energy Nuclear Agency schedule.

8893 (Juel-Spez—146, pp 134) **HP 9835 software developments.** Broekel, E. Mar 1982. NTIS (US Sales Only), PC A08/MF A01.

In Annual report 1981.

8894 (KFK—3333) READKO - a subroutine package for centralized input- and output operations in KAPROS (Version 1.8). Kuefner, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1982. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82750988.

Subroutines are presented for the FORTRAN statements related to unformated (binary) data transfer. The cells are identical for all file realizations supported by KAPROS (data blocks, external units). Only at run-time of a module the actual realizations of the files are fixed. In this way, the input- and output-statements of a program are centralized, thereby greatly facilitating the KAPROS implementation of a program as well as the adoption of a KAPROS module for a 'stand alone' environment.

8895 (LPC—81-11) Micro-controlled universal message multiplexer. Fontaine, G.; Guglielmi, L.; Jaeger, J.J.; Szafran, S. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1981. 12p. (CONF-810539—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82703399.

From Conference on the application of microprocessors to high energy physics experiments; Geneva, Switzerland (4 May 1981).

Based on the Motorola 6800, this multiplexer is designed to provide a microprocessor development tool in the specific environment of a high energy physics laboratory. The basic philosophy of this device is to allow communication of a target (prototype) processor with a host computer under control of a human operator. The host can be an experimental on-line computer or any remote machine with a time-sharing network. It is thus possible to speed up design and debugging of a physics application program by taking advantage of the sophisticated resources usually available in a computer centre (powerful editor, large disk space, source management via "Patchy" etc...). In addition to the classical cross-macroassembler, a loader is available on the host for down-line loading binary code, via the multiplexer, into the prototype memory. Such a scheme is easiextended to the communication of any host interactive processing program with a data acquisition microprocessor, and provides the latter with a convenient and easily portable extension of its computing power. A typical application of this mode is described in a separate paper.

8896 (NP—2906270) Sensitivity model. Vester, F.; von Hesler, A. (Umweltbundesamt, Berlin (Germany, F.R.)). Aug 1980. 284p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE82906270.

In 1972, the year of which preliminary work towards this study was commenced, the word ecology was still not very widely used. The Regionale Planungsgemeinschaft Untermain was however confronted with problems connected with the ecology of its densely populated area. Excellent information was available, and the necessary legal decisions to be able to keep the main disturbing factors in such an area - air and water pollution, noise - under control through consistent regional planning were being made. Responsible circles were also well aware of the fact that ecological burdens are not so much the result of the individual factors as of their joint effects. It was and is therefore very important to establish the relationships between the various interacting factors. This study is based on the fundamental conviction that one is dealing with natural relationships that follow a certain system and that it must be possible to demonstrate this with a model. The sensitivity model represents a completely new approach to recording the important relationships which determine the quality of life in an area; at the same time, this model allows one to recognize the limits for the burdens that can be placed upon it.

8897 (ORNL/CSD/TM—176) PICTURA: a program to draw three-dimensional surfaces. McCollough, D.H.; McGaffey, R.W.; Penny, S.K. (Oak Ridge National Lab., TN (USA)). Nov 1982. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01. Order Number DE83003385.

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PICTURA was originally written by Melvin L. Prueitt at Los Alamos National Laboratory. Designed to be called as subroutine from a programmer's source code, PICTURA can draw three-dimensional surfaces with hidden lines optionally removed and with designated elevations in the surface drawn in selected colors. PICTURA can now be used as a stand-alone program through the use of a user interface. The user issues simple commands to set up his data, choose a viewpoint, and specify various other options. When running in a batch mode, PICTURA can produce a series of plots on several different plotting devices. When running in an interactive mode, the user can draw a surface on a graphics terminal, change the options and redraw until the plot is satisfactory. The program uses the DISSPLA graphics package. This report serves as a reference for using PICTURA as a subroutine called from a user's program or as a package complete with user-oriented commands that require little or no programming experience.

8898 **(SAND—82-0945) MOVIE.BYU user document.** Preece, D.S.; Lewis, B.A. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). Sep 1982. Contract AC04-76DP00789. 162p. NTIS, PC A08/MF A01. Order Number DE83002629.

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Complete user instructions are given for the six computer programs which currently make up the MOVIE.BYU system. These programs have the power to manipulate and display three-dimensional geometric models. They are particularly useful for post processing of finite element models.

8899 **(UCID—19595) NASSI: a structured flowchart drawing program.** Wong, S. (Lawrence Livermore National Lab., CA (USA)). 5 Nov 1982. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01. Order Number DE83003318.

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The Nassi-Shneiderman structured flowchart symbols are flowcharting analogies to some of the structured programming constructs, NASSI, a FORTRAN program, was written to create and modify structured flowcharts. The user interacts with the program through an alphanumeric terminal. The output file containing the structured flowcharts may be printed on a line printer. The program was written to run on the LSI-11/02 computer under the RT-11, Version 3, operating system. However, it should be easily transportable because of its limited use of the nonstandard subroutines ASSIGN, DECODE, and ENCODE. The output file can be easily edited by the text editor TECO for insertion into a MACRO or FORTRAN source code as a block of comment lines.

8900 **(UCRL—88004) Language issues in programming environments.** Blattner, M.; Zimmerman, D. (Lawrence Livermore National Lab., CA (USA)). 1983. Contract W-7405-ENG-48. 13p. (CONF-830105—1). NTIS, PC A02/MF A01. Order Number DE82022062.

From Symposium on principles of programming languages; Austin, TX, USA (24 Jan 1982).

When planning an automated programming-support environment, questions concerning language design arise. In this paper we consider problems such as why language-related issues occur, what is the nature of these questions, and how the software life cycle affects language structures; in addition, we consider how language problems in environments impact the target language of the programming-support environment. We define the programming life cycle as a series of models of the system to be developed. These models are represented by data structures and languages. We propose a set of language-building mechanisms called semantic frames or S-frames that will assist in developing the models and languages required for the programming-support environment.

8901 **HP-67/97 and TI-59 programs to fit the normal and log-normal distribution functions by linear regression.** Spencer, B.B.; Lewis, B.E. (Oak Ridge National Lab., TN). *Powder Technology;* **27**: 219-226(1980).

Programs for the HP-67/97 and Ti-59 programmable calculators have been written to fit data to the normal and log-normal distribution functions using linear regression. Each program calculates the value of the error function, erf, and the inverse error function, erf^{-1}, in fitting the distribution functions. The erf is calculated using its series expansion. The erf^{-1} is calculated by successive approximations using generated values of the erf and the Newton-Raphson method in conjunction with an initial guessing function to accelerate convergence. The coefficient of determination is calculated in order to determine which distribution best fits the data. Both the mean and standard deviation of the distribution function can be determined from the linear regression; therefore the program is useful in several areas, such as settler design, tracer data analysis and particulate surface area determinations.

9903 Information Handling

REFER ALSO TO CITATION(S) 7870

8902 **Technological information exchange among developing countries: developing an appropriate technology data base.** Blum, J. (Univ. of Denver, CO). pp 256-261 of Agriculture, rural energy and development. Ganapathy, R.S. (ed.). Ann Arbor, MI; University of Michigan (1981).

From 2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development; Denver, CO, USA (10 Oct 1980).

Two data bases are described. DEVELOP contains scientific, technological and industrial information in the areas of solar energy, alternative energies, energy conservation, small farm agriculture, appropriate technology, and urban development for developing countries. TECHNOTEC is a commercial on-line data base available from the developed world for technology transfer of appropriate technologies. The countries involved in supplying information for the DEVELOP data base are Guatemala, Peru, Egypt, Pakistan, and Korea. (RJC)

9904 Law

REFER ALSO TO CITATION(S) 6947

9905 Civilian Defense

8903 **(AD-A—114835/2) Ventilation host and risk area techniques. Final report Aug 80-Apr 82.** York, S.B. III; Reeves, R.J.; Wallace, R.J. (Research Triangle Inst., Research Triangle Park, NC (USA). Applied Ecology Dept.). Apr 1982. 151p. NTIS, PC A08/MF A01.

This study consisted of an investigation into several aspects of providing ventilation in counterforce risk- and host-area shelter facilities. Ventilation concepts, including the characteristics of methods for providing ventilation and the shelter characteristics affecting ventilation, were reviewed. Ventilation kit requirements were developed as a function of shelter ventilating characteristics. In defining ventilation kit requirements, optimal ventilation kit deployment (so as to minimize the number of devices required per shelter story) was assumed. Data derived from the NSS-CRP Master File and from a sample of NSS shelter facilities were employed to define the ventilating characteristics of the shelter facilities in each counterforce risk and host county. These data then were used along with pertinent counterforce risk- and host-area characteristics (shelter requirements and zonal ventilation requirements) to estimate the ventilation kit requirements by county, counterforce area, and FEMA Region. Estimates were computed under both 'best case' and 'worst case' assumptions. Under the 'best case' assumption, wind driven ventilation could deliver 8,692 cfm to any aboveground story. No shelter story could be adequately ventilated by wind-driven ventilation under the 'worst case' assumption. In computing the ventilation kit requirements, the numbers of shelter stories requiring no ventilation devices, only Kearny pumps, only PVKs, and combinations of Kearny pumps and PVKs were compiled.

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In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German; are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Information Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Academy of Natural Sciences of Philadelphia, PA (USA). Dept. of Malacology
Ecological studies of wood-boring bivalves in the vicinity of the Oyster Creek Nuclear Generating Station. Progress report, December 1981-February 1982, 8:7576 (R:US)

Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.
Environmental assessment of combustion modification controls for stationary internal combustion engines. Final report Sep 78-Jul 79, 8:8297 (R:US)

ADESCO, Tucson, AZ (USA)
Process for efficient fermentation and distillation for alcohol. Final report, 12 August 1981-15 June 1982, 8:7092 (R:US)

Aerospace Corp., El Segundo, CA (USA)
Assessment of methane-related fuels for automotive fleet vehicles: executive summary, 8:7892 (R:US)

AiResearch Mfg. Co., Torrance, CA (USA)
Study of vacuum systems for a heat engine/flywheel automotive propulsion system. Final report, 8:7890 (R:US)

Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)
An evaluation of occupational exposure to hydrazine (h-70) during routine maintenance tasks associated with the F-16 Emergency Power Unit. Technical report, 8:8285 (R:US)

Akademiet for de Tekniske Videnskaber, Lyngby (Denmark)
Hydroelectric power in Greenland, 8:7095 (R:DK:In Danish)

American Planning Association, Knoxville, TN. Knoxville Area Section
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Proceedings of the cellulose I conference, 8:7800 (R:US)

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Methodology for algorithm development through schema transformations, 8:8888 (R:US)
University of florida integrated utility system conceptual feasibility analysis and assessment, 8:7865 (R:US)

Arinc Research Corp., Annapolis, MD (USA)
Role of design complexity in forecasting reliability and availability for electric-power-generating units. Final report, 8:7239 (R:US)

Arizona Public Service Co., Phoenix (USA)
Airport solar photovoltaic concentrator. Project status report, 1 July 1982-31 October 1982, 8:7148 (R:US)

Atlantic Richfield Co., Harvey, IL (USA)
Coal-oil mixture as a utility boiler fuel. Volume 2. Coal-oil mixture preparation. Final report, 8:6862 (R:US)

Augsburg Univ. (Germany, F.R.). Fakultaet fuer Wirtschafts- und Sozialwissenschaft
Analysis and planning of the environment by distributing decisions, 8:8887 (R:DE:In German)

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Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.
In-air vibration analysis of Three Mile Island Unit-2 once-through steam generator tubes. Volume 1, 8:7468 (R:US)

Battelle Columbus Labs., OH (USA)
Characterization of the contamination in the TMI-2 reactor coolant system. Final report, 8:7589 (R:US)

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Coal-oil mixture as a utility boiler fuel. Volume 2. Coal-oil mixture preparation. Final report, 8:6862 (R:US)
Conceptual capital-cost estimate and facility design of the Mirror-Fusion Technology Demonstration Facility, 8:8876 (R:US)
Corrosion studies: geopressured aquifer gas production. Final report 1 Mar 80-27 Feb 81, 8:6955 (R:US)

Bendix Corp., Kansas City, MO (USA)
Gas analysis by time-of-flight mass spectrometry. Final report, 8:8238 (R:US)

Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations
Uranium resources in fine-grained carbonaceous rocks of the Great Divide Basin, south-central Wyoming. National Uranium Resource Evaluation, 8:6982 (R:US)

Bettis Atomic Power Lab., Pittsburgh, PA (USA)
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Bochum Univ. (Germany, F.R.). Abt. Chemie
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Brown Univ., Providence, RI (USA)
Unified approach to characterization of collisions between reactive radical pairs in solution. Technical progress report, 8:8097 (R:US)

Brown Univ., Providence, RI (USA). Dept. of Engineering
Some aspects of the plastic deformation of phase mixtures with coarse microstructures, 8:7902 (R:US)

Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)
Content of minerals and trace elements in meals, 8:8029 (R:DE:In German)

Bundesforschungsanstalt fuer Fischerei, Hamburg (Germany, F.R.). Inst. fuer Kuesten- und Binnenfischerei
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Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)
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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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82-117	NTIS (US Sales Only), PC A11/MF A01	DE82750998	MN -11	8:7832
82-118	Bonn, Germany, F.R.; Bundesministerium fuer Forschung und Technologie (1982).			8:7850
82-121	NTIS (US Sales Only), PC A07/MF A01	DE82750996	MN -38	8:8114
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81-052	Bonn, Germany; Bundesministerium fuer Forschung und Technologie (1981).			8:8483
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31978	NTIS, PC A02/MF A01	DE83002216	MN -15	8:7067
31985	NTIS, PC A02/MF A01	DE83002215	MN -34D	8:8199
32095	NTIS, PC A02/MF A01	DE83003174	MN -37	8:8239
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3261	NTIS (US Sales Only), PC A03/MF A01	DE82702893	MN -34C	8:8690
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	See ORNL/Sub-81-40447/1	DE82019857	MN -95d	8:7800
CONF-7811206-	(Energy supply and development planning of communities meeting, Koeln, F.R. Germany, 30 Nov 1978)			
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CONF-790519-	(European nuclear conference, Hamburg, F.R. Germany, 6-11 May 1979)			
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CONF-790646-	(International colloquium on irradiation for reactor safety programmes, Petten, Netherlands, 25-28 Jun 1979)			
12	*See* GKSS-79/E/54	DE82750347	MN -80	8:7904
CONF-790770-	(Management assessment of peat as an energy resource meeting, Arlington, VA, USA, 22-24 Jul 1979)			
	Institute of Gas Technology, IIT Center, 3424 South State Street, Chicago, IL 60616, $40.00			8:6688
CONF-790807-	(Topical conference on reactor operating experience, Arlington, TX, USA, 5-8 Aug 1979)			
	Trans. Am. Nucl. Soc., Suppl., 32: 10-11(1979)			8:7574
	Trans. Am. Nucl. Soc., Suppl., 32: 36-37(1979)			8:7582
CONF-7911181-	(Energy concepts for industrial works meeting, Nuernberg, F.R. Germany, 29-30 Nov 1979)			
1	NTIS (US Sales Only), PC A03/MF A01	DE82906279	MN -95d	8:7792
2	NTIS (US Sales Only), PC A02/MF A01	DE82906264	MN -95d	8:7793
CONF-7911182-	(IAEA regional training seminar on operation and maintenance of nuclear power plants in developing countries, Kalpakkam, India, 5-9 Nov 1979)			
1	*See* PAEC(C)VI-B-79012	DE82703403	MN -2	8:7453
CONF-8003183-	(13. meeting on energy consumption in sewage treatment plants and low-pollution treatment and disposal of sewage sludge and waste, Essen, F.R. Germany, 5-7 Mar 1980)			
	NTIS (US Sales Only), PC A99/MF A01	DE83900098	MN -95e	8:7854
CONF-8005226-	(7. seminar on extraction methods in chemistry, Cikhaj, Czechoslovakia, 14 May-16 Apr 1980)			
Summ.	*See* INIS-mf-7134	DE83780048	MN -4	8:8043
CONF-8006242-	(Conference on materials problems of light water reactors, Vsetin, Czechoslovakia, 10-12 Jun 1980)			
	See INIS-mf-7217	DE83780049	MN -78	8:7520
CONF-8008162-	(3. workshop on Lie-admissible formulations, Boston, MA, USA, 4-9 Aug 1980)			
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CONF-8009287-	(Anniversary of the Suedhessische Gas Wasser A.G. meeting, Darmstadt, F.R. Germany, 19 Sep 1980)			
1	NTIS (US Sales Only), PC A03/MF A01	DE82906255	MN -98	8:7700
CONF-8009288-	(Seminar on diesel engines, Wuppertal, F.R. Germany, 18-19 Sep 1980)			
1	NTIS (US Sales Only), PC A03/MF A01	DE82906263	MN -96	8:7876
CONF-8010299-	(2. symposium of International Association for the Advancement of Appropriate Technology for Developing Countries - agriculture, rural energy and development, Denver, CO, USA, 10-12 Oct 1980)			
	University of Michigan, Administration Division of Research, Ann Arbor, MI 48109, $15.00			8:8398

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	Trans. Am. Nucl. Soc., 35: 669-671(Nov 1980)			8:7498
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CONF-810106-	(19. Aerospace Sciences meeting, St Louis, MO, USA, 12-15 Jan 1981)			
	AIAA Pap., No. 81-0244, vp(1981)			8:7112
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	AIAA Pap., No. 81-0032, vp(1981)			8:7780
	AIAA Pap., No. 81-0182, vp(1981)			8:8110
CONF-810140-	(Community energy planning conference, Gatlinburg, TN, USA, 29-30 Jan 1981)			
	NTIS MF A01	DE83900066	MN -13	8:7717
CONF-810153-	(2. special symposium on natural radiation environment, Bombay, India, 19-23 Jan 1981)			
3	NTIS, PC A02/MF A01	DE83003345	MN -11	8:8302
CONF-810287-	(Seminar on supply, operation and radioactive waste disposal of nuclear power plants, Juelich, F.R. Germany, 10-13 Feb 1981)			
1	*See* Juel-Conf-41	DE82750694	MN -70	8:7512
CONF-8103145-	(6. international technical conference on slurry transportation, Las Vegas, NV, USA, 24-27 Mar 1981)			
	Slurry Transport Association, 490 L'Enfant Plaza East, SW, Suite 3210, Washington, DC 20024			8:6864
CONF-810485-	(2. workshop on grand unification, Ann Arbor, MI, USA, 24-26 Apr 1981)			
	Harrison M. Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109			8:8599
CONF-8104179-	(3. Southern Philippines Physics Society convention, Iligan City, Philippines, 2 Apr 1981)			
1	*See* PAEC(C)VI-A-81004	DE82703402	MN -2	8:7452
CONF-810539-	(Conference on the application of microprocessors to high energy physics experiments, Geneva, Switzerland, 4-6 May 1981)			
12	*See* LPC-81-11	DE82703399	MN -32	8:8895
13	*See* LPC-81-12	DE82703400	MN -32	8:8119
CONF-8105118-	(1. groundwater monitoring symposium, Columbus, OH, USA, 29 May 1981)			
	NTIS, PC A05/MF A01	DE82905817	MN -11	8:8333
CONF-8105158-	(Seminar on radionuclide technology, Karlsruhe, F.R. Germany, 13-15 May 1981)			
Absts.	*See* KFK-AFR-003	DE82780794	MN -51	8:6983
CONF-8105173-	(3. seminar on the desulphurization of fuels and combustion gases, Salzburg, Austria, 18-22 May 1981)			
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CONF-8105193-	(2. meeting on corrosion due to salt water, Wilhelmshaven, F.R. Germany, 14-15 May 1981)			
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CONF-8106144-	(Health Physics Society annual meeting, Louisville, KY, USA, 21-26 Jun 1981)			
11	*See* PNL-SA-9529	DE83002663	MN -41	8:8412
CONF-810760-	(International conference on high energy physics, Lisbon, Portugal, 9-15 Jul 1981)			
19	*See* DESY-81-063	DE82750364	MN -34D	8:8517
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CONF-810906-	(10. European conference on controlled fusion and plasma physics, Moscow, USSR, 14-19 Sep 1981)			
15	*See* IPF-81-7	DE82750947	MN -20a	8:8833
CONF-810928-	(Symposium on neutron dosimetry, Germantown, MD, USA, 15-16 Sep 1981)			
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CONF-8109131-	(2. IAEA research co-ordination meeting on the treatment of spent ion-exchange resins, Toronto, Canada, 21-25 Sep 1981)			
2	*See* INIS-mf-7138	DE82702909	MN -25	8:8100

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Abstr.	*See* INIS-mf-7223	DE83780105	MN -70	8:7004
CONF-811130-	(3. annual DOE participants information meeting on low-level waste management, New Orleans, LA, USA, 4-6 Nov 1981)			
	See ORNL/NFW-81/34	DE82020597	MN -70	8:7013
CONF-811143-	(8. annual colloquium of the Nuclear Safety Project, Karlsruhe, F.R. Germany, 16-17 Nov 1981)			
	See KFK-3270	DE82750693	MN -78	8:7621
CONF-811173-	(Workshop on surface subsidence due to underground mining, Morgantown, WV, USA, 30 Nov-2 Dec 1981)			
	NTIS, PC A14/MF A01	DE82020615	MN -88	8:6816
CONF-811176-	(6. annual firing systems conference, Los Alamos, NM, USA, 17-18 Nov 1981)			
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CONF-8111123-	(Information meeting on district heating and the possible contribution of nuclear energy, Bern, Switzerland, 16-17 Nov 1981)			
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1	*See* UCRL-88199	DE83001190	MN -25	8:7923
CONF-820202-	(AICHE 1982 national winter meeting, Orlando, FL, USA, 28 Feb-3 Mar 1982)			
18	*See* KFK-3310	DE82750663	MN -22	8:6988
CONF-820304-	(183. American Chemical Society annual meeting, Las Vegas, NV, USA, 27 Mar-2 Apr 1982)			
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1	*See* RFP-3349	DE83000692	MN -25	8:7993
CONF-820409-	(Scanning electron microscopy annual meeting, Anaheim, CA, USA, Apr 1982)			
5	*See* BNL-32095	DE83003174	MN -37	8:8239
CONF-820491-	(Geothermal energy exploration and resource assessment technical conference, Salt Lake City, UT, USA, 5-7 Apr 1982)			
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CONF-820508-	(Spring meeting of the Electrochemical Society, Montreal, Canada, 9-14 May 1982)			
6	*See* LBL-14708	DE83001895	MN -4	8:8095
CONF-820553-	(12. anomalous absorption conference, Santa Fe, NM, USA, 10-13 May 1982)			
3	*See* NRL-MR-4893	DE83002294	STD -21	8:8842
CONF-820609-	(American Nuclear Society annual meeting, Los Angeles, CA, USA, 6-11 Jun 1982)			
	Trans. Am. Nucl. Soc., 41: 345-347(Jun 1982)			8:6999
	Trans. Am. Nucl. Soc., 41: 345(Jun 1982)			8:7065
	Trans. Am. Nucl. Soc., 41: 347-350(Jun 1982)			8:7066
	Trans. Am. Nucl. Soc., 41: 356-358(Jun 1982)			8:8124
CONF-8206119-	(15. world gas conference, Lausanne, Switzerland, 14-18 Jun 1982)			
1	Institute of Gas Technology, 3424 South State Street, IIT Center, Chicago, IL 60616		MN -92b	8:6957
CONF-820713-	(Institute of Nuclear Materials meeting, Washington, DC, USA, 19-21 Jul 1982)			
28	*See* PNL-SA-10514	DE83003472	MN -15	8:7075
CONF-820718-	(21. international conference on high energy physics, Paris, France, 29 Jul-8 Aug 1982)			
19	*See* BNL-31985	DE83002215	MN -34D	8:8199
CONF-820725-	(29. annual Sagamore Army materials research conference, Lake Placid, NY, USA, 19-23 Jul 1982)			
3	*See* SAND-82-1627C	DE83002870	MN -25	8:7920
CONF-820727-	(3. joint intermag-magnetism and magnetic materials conference, Montreal, Canada, 17-23 Jul 1982)			
5	*See* LBL-14797	DE83001551	MN -25	8:7971
CONF-820747-	(Accreting neutron star conference, Garching, F.R. Germany, 19-24 Jul 1982)			
2	*See* UCRL-88329	DE83002814	MN -34D	8:8478
CONF-820757-	(International colloquium on the history of particle physics, Paris, France, 21 Jul 1928,-23 Jul 1982)			
1	*See* LA-UR-82-3170	DE83001982	MN -34D	8:8775
CONF-820802-	(International meeting on thermal nuclear reactor safety, Chicago, IL, USA, 29 Aug-2 Sep 1982)			
48	*See* BNL-31908	DE83002219	MN -80	8:7585

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CONF-820818-	(International coal conversion conference, Pretoria, South Africa, 16-20 Aug 1982)			
2	Institute of Gas Technology, 3424 South State Street, IIT Center, Chicago, IL 60616		MN -90c	8:6694
CONF-820849-	(Summer study in energy efficient buildings, Santa Cruz, CA, USA, 22-28 Aug 1982)			
13	*See* LBL-14914	DE83003277	MN -95d	8:7796
14	*See* LBL-14784	DE83003635	MN -95d	8:7795
CONF-820887-	(2. photovoltaic residential project integration meeting, Las Cruces, NM, USA, 19-20 Aug 1982)			
Absts.	*See* SAND-82-1811	DE83000530	MN -63	8:7149
CONF-820892-	(Oil Shale Task Force conference, Vail, CO, USA, 9-12 Aug 1982)			
2	*See* PNL-SA-10598	DE83002006	MN -91	8:6978
CONF-820895-	(DARPA dynamic synthesis program review meeting, Albuquerque, NM, USA, 5 Aug 1982)			
1	*See* SAND-82-2335C	DE83001788	MN -45	8:7976
CONF-820906-	(16. IEEE photovoltaics specialists conference, San Diego, CA, USA, 28-30 Sep 1982)			
31	*See* LBL-15063	DE83003275	MN -63e	8:7121
CONF-820911-	(Symposium on low level waste disposal, Washington, DC, USA, 29-30 Sep 1982)			
3	*See* PNL-SA-10554	DE83002750	MN -70B	8:7047
CONF-820929-	(IUPAP international conference on magnetism, Kyoto, Japan, 6-10 Sep 1982)			
9	*See* BNL-31919	DE83000818	MN -34A	8:7999
CONF-820940-	(Passive and hybrid solar energy update conference, Washington, DC, USA, 15-17 Sep 1982)			
8	*See* LBL-15131	DE83003663	MN -59	8:7797
CONF-820948-	(12. symposium on fusion technology, Juelich, F.R. Germany, 13-17 Sep 1982)			
5	*See* LBL-14317	DE83002329	MN -20a	8:8866
CONF-820950-	(Conference on the neutron and its applications, Cambridge, UK, 13-17 Sep 1982)			
5	*See* BNL-31978	DE83002216	MN -15	8:7067
CONF-820957-	(International conference EXAFS and near edge structures, Frascati, Italy, 13-17 Sep 1982)			
3	*See* BNL-31939	DE83002217	MN -25	8:8000
CONF-820977-	(3. internatonal conference on vibrations at surfaces, Pacific Grove, CA, USA, 1-4 Sep 1982)			
1	*See* LBL-14556	DE83001568	MN -25	8:7913
2	*See* LBL-14552	DE83002328	MN -34	8:8502
CONF-820979-	(International conference on nucleus-nucleus collisions, East Lansing, MI, USA, 27 Sep-1 Oct 1982)			
2	*See* LBL-15175	DE83003666	MN -34D	8:8709
CONF-820982-	(Yield, flow and fracture in polycrystals meeting, Glasgow, UK, 1 Sep 1982)			
1	*See* DOE/ER/10556-94	DE83001624	MN -25	8:7902
CONF-820985-	(8. European conference on thermophysical properties - high temperatures high pressure, Baden-Baden, F.R. Germany, 27 Sep-1 Oct 1982)			
1	*See* LBL-14722	DE83003278	MN -70	8:7011
CONF-821011-	(IEEE nuclear science symposium, Washington, DC, USA, 20-22 Oct 1982)			
16	*See* UCRL-88040	DE83003253	MN -22	8:6991
17	*See* LBL-14414	DE83003051	MN -37	8:8229
CONF-821012-	(Institute for management sciences/Operations Research Society of America joint meeting, San Diego, CA, USA, 25-27 Oct 1982)			
3	*See* EGG-M-25882	DE83002995	MN -70B	8:7000
CONF-821024-	(10. international symposium on discharges and electrical insulation in vacuum, Columbia, SC, USA, 25-28 Oct 1982)			
7	*See* SAND-82-1141C	DE83002148	MN -28	8:8873
CONF-821035-	(Combustion Insitute symposium on western states section, Livermore, CA, USA, 11-12 Oct 1982)			
7	*See* SAND-82-8865	DE83001948	MN -13	8:8141
8	*See* LBL-15062	DE83002229	MN -11	8:8293
CONF-821037-	(10. water reactor safety research information conference, Gaithersburg, MD, USA, 12-15 Oct 1982)			
32	*See* PNL-SA-10743	DE83003465	MN -78	8:7463
33	*See* EGG-M-24782	DE83003250	MN -78	8:7588
34	*See* EGG-M-20782	DE83003251	MN -80	8:7531
35	*See* EGG-M-21282	DE83002997	MN -78	8:7587
CONF-821038-	(10. annual DOE compatibility conference, Albuquerque, NM, USA, 26-29 Oct 1982)			
5	*See* MLM-3015(OP)	DE83001534	MN -25	8:8066
CONF-821048-	(5. Life Sciences symposium on synthetic fossil fuel technologies, Gatlinburg, TN, USA, 24-27 Oct 1982)			
2	*See* PNL-SA-10824	DE83002707	MN -90d	8:6926
CONF-821050-	(Cyclotron facility workshop, Bloomington, IN, USA, 27-31 Oct 1982)			
2	*See* LA-UR-82-3466	DE83003549	MN -34C	8:8657
CONF-821051-	(International conference on fundamentals of thermochemical biomass conversion, Estes Park, CO, USA, 18-22 Oct 1982)			
3	*See* LBL-15143	DE83003758	MN -61a	8:7122

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CONF-821089-	(6. international workshop on laser interaction and related plasma phenomena, Monterey, CA, USA, 25-29 Oct 1982)			
1	*See* SAND-82-2028C	DE83002186	MN -28	8:8875
CONF-821102-	(6. international conference on powder metallurgy, Brno, Czechoslovakia, 10-12 Nov 1982)			
27	*See* PNL-SA-10431	DE83002699	MN -70	8:7044
CONF-821103-	(American Nuclear Society winter meeting, Washington, DC, USA, 14-19 Nov 1982)			
30	*See* HEDL-SA-2715-FP	DE83003371	MN -20d	8:8853
31	*See* HEDL-SA-2741-FP	DE83002911	MN -20c	8:8854
34	*See* PNL-SA-10524	DE83003459	MN -70	8:7045
CONF-821107-	(6. international symposium on the scientific basis for radioactive waste management, Boston, MA, USA, 1-4 Nov 1982)			
7	*See* LA-UR-82-3063	DE83001973	MN -25	8:7010
18	*See* SAND-82-1338C	DE83002140	MN -34A	8:8005
20	*See* SAND-82-1587C	DE83002553	MN -25	8:8006
21	*See* SAND-82-1594C	DE83002516	MN -70	8:7050
23	*See* SAND-82-1258C	DE83002832	MN -70	8:7049
24	*See* PNL-SA-10549	DE83002698	MN -70	8:7046
CONF-821111-	(29. national symposium on American Vacuum Society, Baltimore, MD, USA, 16-19 Nov 1982)			
10	*See* UCRL-87732	DE83001497	MN -20	8:8880
12	*See* LBL-14631	DE83002233	MN -20a	8:8867
13	*See* UCRL-87756	DE83002469	MN -20d	8:8845
14	*See* UCRL-87766	DE83000709	MN -20	8:8846
CONF-821122-	(Conference on glass and ceramic materials, Oak Ridge, TN, USA, 8-12 Nov 1982)			
5	*See* MLM-3022(OP)	DE83001758	MN -25	8:7972
CONF-821123-	(7. conference on the application of accelerators in research and industry, Denton, TX, USA, 8-10 Nov 1982)			
4	*See* SAND-82-1596C	DE83002519	MN -28	8:8189
5	*See* PNL-SA-10559	DE83003468	MN -34A	8:8508
8	NTIS, PC A02/MF A01	DE83003445	MN -22	8:7077
9	*See* SAND-82-1560C	DE83002147	MN -20c	8:8874
10	*See* UCRL-87831	DE83003375	MN -20	8:8881
CONF-821126-	(5. DOE computer security conference, Knoxville, TN, USA, 16-18 Nov 1982)			
2	*See* HEDL-SA-2785-FP	DE83002239	MN -15	8:7070
CONF-821127-	(ASM conference on current solutions to hydrogen problems in steels, Washington, DC, USA, 1 Nov 1982)			
1	*See* DOE/ER/06039-4	DE83001526	MN -25	8:7901
2	*See* DOE/ER/06039-3	DE83001527	MN -25	8:7900
CONF-821128-	(24. American Physical Society annual meeting, New Orleans, LA, USA, 1-5 Nov 1982)			
1	*See* UCRL-87946	DE83001651	MN -37	8:8847
CONF-821131-	(APCA Pacific Northwest International section annual meeting, Vancouver,B.C., Canada, 15-17 Nov 1982)			
1	*See* PNL-SA-10621	DE83003470	MN -11	8:8298
2	*See* PNL-SA-10630	DE83003463	MN -95	8:7821
CONF-821132-	(Workshop on mechanics of fracture and damage, Stone Mountain, GA, USA, 22 Nov 1982)			
1	*See* SAND-82-2255C	DE83002509	MN -25	8:7994
CONF-821201-	(Fall DECUS US Symposium, Anaheim, CA, USA, 6-10 Dec 1982)			
2	*See* KMSF-U-1245	DE83002542	MN -21	8:8865
CONF-821211-	(5. DOE battery and electrochemical contractor's conference, Crystal City, VA, USA, 7-9 Dec 1982)			
1	*See* SAND-82-2466C	DE83002510	MN -94b	8:7686
CONF-830103-	(2. international topical meeting on nuclear thermalhydraulics, Santa Barbara, CA, USA, 11-13 Jan 1982)			
2	*See* LA-UR-82-1800	DE82017329	MN -78	8:7649
3	*See* LA-UR-82-1787	DE82017332	MN -78	8:7648
4	*See* LA-UR-82-1820	DE82018387	MN -78	8:7650
5	*See* LA-UR-82-1821	DE82018388	MN -78	8:7651
6	*See* LA-UR-82-1768	DE82018431	MN -78	8:7645
7	*See* LA-UR-82-1665	DE82018382	MN -78	8:7638
8	*See* LA-UR-82-1666	DE82018383	MN -78	8:7639
9	*See* LA-UR-82-1718	DE82018450	MN -78	8:7643
10	*See* LA-UR-82-1717	DE82018456	MN -78	8:7642
11	*See* LA-UR-82-1716	DE82018455	MN -78	8:7641
12	*See* LA-UR-82-1759	DE82018448	MN -78	8:7644
13	*See* LA-UR-82-1715	DE82018453	MN -79p	8:7640
14	*See* LA-UR-82-1786	DE82017333	MN -78	8:7647
15	*See* LA-UR-82-1769	DE82016281	MN -78	8:7646
16	*See* SAND-82-0913C	DE82018744	MN -78	8:7661
17	*See* SAND-82-0871C	DE82018299	MN -78	8:7659
18	*See* LA-UR-82-1928	DE82019572	MN -78	8:7652
19	*See* SAND-82-0903C	DE82018295	MN -80	8:7660
20	*See* SAND-82-0917C	DE82019736	MN -80	8:7662
21-Rev.1	*See* RHO-RE-SA-8-Rev.1	DE82020725	MN -78	8:7658
22	*See* LA-UR-82-1664	DE83000351	MN -78	8:7637
CONF-830104-	(International conference on constitutive laws for engineering materials: theory and application, Tucson, AZ, USA, 10-14 Jan 1983)			
1	*See* SAND-82-1633C	DE82018297	MN -34B	8:8472

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2	*See* UCRL-86966	DE82018066	MN -25	8:8726
3	*See* LA-UR-82-2167	DE82019532	MN -11	8:8468
4	*See* SAND-81-1875C	DE82020034	MN -70	8:8470
5	*See* SAND-81-2443C	DE82020182	MN -38	8:8471
CONF-830105-	(Symposium on principles of programming languages, Austin, TX, USA, 24-26 Jan 1982)			
1	*See* UCRL-88004	DE82022062	MN -32	8:8900
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3573-32	*See* DOE/EV/13573-32	DE83003060	MN -11	8:8303
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76-020.107	NTIS, PC A04/MF A01	DE83003086	STD -90e	8:7238
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81-063	NTIS (US Sales Only), PC A02/MF A01	DE82750364	MN -34D	8:8517
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81-065	NTIS (US Sales Only), PC A02/MF A01	DE82750359	MN -37	8:8200
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35-79/ 02	Hamburg, Germany; Deutsches Elektronen-Synchrotron (1979).			8:8549
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2	NTIS, PC A08/MF A01	DE82019511	STD -95e	8:7856
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18	NTIS, PC A02/MF A01	DE83003309	STD -95e	8:7834
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1	NTIS, PC A05/MF A01	DE83002892	STD -95e	8:7861

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DOE/CS/31500-T1	NTIS MF A01	DE83002207	MN -59a	8:7163
DOE/CS/50296-4	NTIS, PC A08/MF A01	DE83003155	STD -95e	8:7862
DOE/DP-0053-1125	NTIS MF A01	DE83003369	MN -92a	8:6964
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DOE/ET/35208-4	NTIS, PC A04/MF A01	DE83002800	MN -78	8:7455
DOE/ET/52002-T2	MIT Press, 28 Carleton St., Cambridge, MA 02142, $30.00			8:8776
DOE/ET/52040-266	NTIS, PC A03/MF A01	DE83002912	MN -20a	8:8848
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13	NTIS, PC A03/MF A01	DE83002975	STD -11	8:8277
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192	NTIS, PC A04/MF A01	DE83003337	MN -90c	8:6707
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109	NTIS (US Sales Only), PC A07/MF A01	DE82750322	MN -59c	8:7177
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2713	NTIS, PC A14/MF A01	DE83900750	MN -90i	8:6811
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2722	NTIS, PC A05/MF A01	DE83900578	MN -78	8:7589
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2291-107A	*See* CW-WR-76-020.107	DE83003086	STD -90e	8:7238
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81/ 78-THY	NTIS MF A01	DE83002535	MN -34D	8:8562
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82/ 25	NTIS, PC A08/MF A01	DE83900362	MN -11	8:8329
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82-79	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760		MN -79	8:7486
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22160	*See* DOE/ET/34031-8	DE83003102	STD -78	8:7454
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145-82	NTIS MF A01	DE82018509	MN -51	8:6981
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79/ E/ 54	NTIS (US Sales Only), PC A02/MF A01	DE82750347	MN -80	8:7904
80/ E/ 58	NTIS (US Sales Only), PC A02/MF A01	DE82750687	MN -25	8:8143
81/ E/ 26	Geesthacht-Tesperhude, Germany; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1981).			8:8313
81/ E/ 33	NTIS (US Sales Only), PC A05/MF A01	DE82750349	MN -25	8:7969
81/ E/ 44	NTIS (US Sales Only), PC A05/MF A01	DE82750428	MN -25	8:7894
81/ E/ 59	NTIS (US Sales Only), PC A02/MF A01	DE82750688	MN -25	8:8144
81/ E/ 60	NTIS (US Sales Only), PC A02/MF A01	DE82750689	MN -25	8:7905
82/ E/ 7	NTIS (US Sales Only), PC A03/MF A01	DE82750959	MN -23	8:8207
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82/ E/ 9	NTIS (US Sales Only), PC A05/MF A01	DE82750961	MN -04	8:8032
82/ E/ 12	Geesthacht-Tesperhude, Germany, F.R.; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1982).			8:7150
82/ E/ 14	Geesthacht-Tesperhude, Germany, F.R.; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1982).			8:7583
82/ E/ 17	Geesthacht-Tesperhude, Germany; GKSS-Forschungszentrum Geesthacht G.m.b.H. (1982).			8:8236
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21	NTIS (US Sales Only), PC A02/MF A01	DE82750418	MN -78	8:7605
22	NTIS (US Sales Only), PC A03/MF A01	DE82750342	MN -78	8:7606
28	NTIS (US Sales Only), PC A02/MF A01	DE82750419	MN -80	8:7607
43	NTIS (US Sales Only), PC A-5/MF A01	DE82751051	MN -80	8:7503
44	NTIS (US Sales Only), PC A03/MF A01	DE82751056	MN -80	8:7608
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101	Koeln, Germany; Gesellschaft fuer Reaktorsicherheit m.b.H. (1981).			8:7667
110	NTIS (US Sales Only), PC A17/MF A01	DE82750343	MN -78	8:7610
112	NTIS (US Sales Only), PC A04/MF A01	DE82750735	MN -80	8:7611
114	NTIS (US Sales Only), PC A22/MF A01	DE82750966	MN -78	8:7612
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36	NTIS (US Sales Only), PC A04/MF A01	DE82750417	MN -80	8:7504
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280	NTIS (US Sales Only), PC A06/MF A01	DE82750700	MN -48	8:8458
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1108	NTIS (US Sales Only), PC A04/MF A01	DE82751045	MN -48	8:8381
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86	NTIS (US Sales Only), PC A04/MF A01	DE82750704	MN -4	8:8208
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267	NTIS (US Sales Only), PC A07/MF A01	DE82750737	MN -51	8:8461
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710	NTIS (US Sales Only), PC A12/MF A01	DE82750679	MN -48	8:8407
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81-11	NTIS (US Sales Only), PC A03/MF A01	DE82750370	MN -34C	8:8641
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360	NTIS (US Sales Only), PC A04/MF A01	DE82750437	MN -32	8:8241
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2044-F	NTIS (US Sales Only), PC A05/MF A01	DE82702902	MN -4	8:8076
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81-13	Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany, F.R.			8:7721
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1-11	NTIS (US Sales Only), PC A06/MF A01	DE82750339	MN -25	8:7245
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5-215	NTIS (US Sales Only), PC A06/MF A01	DE82750676	MN -25	8:8116
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54-7	NTIS (US Sales Only)	DE82750964	MN -96	8:7829
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7223	NTIS (US Sales Only), PC A03/MF A01	DE83780105	MN -70	8:7004
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116	NTIS (US Sales Only), PC A06/MF A01	DE83780060	MN -37	8:8604
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4-81-788	NTIS (US Sales Only), PC A02/MF A01	DE82702894	MN -34C	8:8692
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1722	NTIS (US Sales Only), PC A05/MF A01	DE82750977	MN -11	8:8343
1725	NTIS (US Sales Only), PC A05/MF A01	DE82750447	MN -25	8:7906
1727	NTIS (US Sales Only), PC A03/MF A01	DE82750449	MN -20d	8:8862
1728	NTIS (US Sales Only), PC A07/MF A01	DE82750360	MN -37	8:8215
1744	NTIS (US Sales Only), PC A13/MF A01	DE82905924	MN -4	8:8498
1746	NTIS (US Sales Only), PC A02/MF A01	DE82750732	MN -20f	8:8841
1755	NTIS (US Sales Only), PC A07/MF A01	DE82750702	MN -34C	8:8605
1760	NTIS (US Sales Only), PC A06/MF A01	DE82750955	MN -76	8:7479
1765	NTIS (US Sales Only), PC A09/MF A01	DE82750987	MN -70	8:7005
1768	NTIS (US Sales Only), PC A09/MF A01	DE82750990	MN -77	8:7480
1776	NTIS (US Sales Only), PC A05/MF A01	DE82750741	MN -11	8:8290
1777	NTIS (US Sales Only), PC A05/MF A01	DE82750986	MN -77	8:7481
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41	NTIS (US Sales Only), PC A04/MF A01	DE82750694	MN -70	8:7512
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123	Juelich, Germany; Kernforschungsanlage (1981).			8:7519
127	NTIS (US Sales Only), PC A08/MF A01	DE82750660	MN -77	8:7570
135	NTIS (US Sales Only), PC A06/MF A01	DE82750659	MN -77	8:7615
136/ Bd.3	Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany			8:7666
136(Bd.5)	NTIS (US Sales Only), PC A04/MF A01	DE82750963	MN -76	8:7616
139	NTIS (US Sales Only), PC A09/MF A01	DE82750953	MN -04	8:8088
145	NTIS (US Sales Only), PC A04/MF A01	DE82751043	MN -34C	8:8638
146	NTIS (US Sales Only), PC A08/MF A01	DE83780035	MN -34C	8:8603
149	Juelich, Germany; Kernforschungsanlage (1982).			8:8018
151	NTIS (US Sales Only), PC A04/MF A01	DE82751057	MN -80	8:7482

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5330	NTIS, PC A04/MF A01	DE83000344	MN -15	8:8108
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4152	NTIS, PC A04/MF A01	DE83002539	MN -32	8:8512
KFK-				
2890	NTIS (US Sales Only), PC A06/MF A01	DE82750421	MN -78	8:7617
3087-B	NTIS (US Sales Only), PC A16/MF A01	DE82750350	MN -25	8:7970
3112B	NTIS (US Sales Only), PC A03/MF A01	DE82750426	MN -04	8:7838
3124	NTIS (US Sales Only), PC A03/MF A01	DE82750671	MN -04	8:8101
3127	NTIS (US Sales Only), PC A02/MF A01	DE82750429	MN -34	8:8606
3130e	NTIS (US Sales Only), PC A03/MF A01	DE82750431	MN -20d	8:7907
3138	NTIS (US Sales Only), PC A03/MF A01	DE82750435	MN -38	8:8135
3150	NTIS (US Sales Only), PC A07/MF A01	DE82750422	MN -80	8:7618
3160	NTIS (US Sales Only), PC A02/MF A01	DE82750361	MN -37	8:8225
3176	NTIS (US Sales Only), PC A04/MF A01	DE82750681	MN -79b	8:7489
3198	NTIS (US Sales Only), PC A03/MF A01	DE82750357	MN -28	8:8188
3202/ 2	NTIS (US Sales Only), PC A16/MF A01	DE82750733	MN -21	8:8863
3205	NTIS (US Sales Only), PC A06/MF A01	DE82750345	MN -25	8:7908
3206	NTIS (US Sales Only), PC A04/MF A01	DE82750416	MN -78	8:7473
3215	NTIS (US Sales Only), PC A03/MF A01	DE83780177	MN -37	8:8243
3221	NTIS (US Sales Only), PC A04/MF A01	DE82750338	MN -78	8:7006
3223	NTIS (US Sales Only), PC A02/MF A01	DE82750354	MN -38	8:8136
3224	NTIS (US Sales Only), PC A05/MF A01	DE82750346	MN -25	8:7909
3228	Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany, F.R.		MN -28	8:8162
3231	NTIS (US Sales Only), PC A03/MF A01	DE82750734	MN -37	8:8226
3234	NTIS (US Sales Only), PC A05/MF A01	DE82750423	MN -80	8:7619
3235	NTIS (US Sales Only), PC A05/MF A01	DE82750446	MN -34C	8:8609
3246	NTIS (US Sales Only), PC A04/MF A01	DE82750438	MN -48	8:8291
3248	NTIS (US Sales Only), PC A22/MF A01	DE82750695	MN -80	8:7513
3251e	NTIS (US Sales Only), PC A04/MF A01	DE82750740	MN -70	8:7007
3252	NTIS (US Sales Only), PC A06/MF A01	DE82750686	MN -20d	8:8864
3264	NTIS (US Sales Only), PC A09/MF A01	DE82750661	MN -15	8:7071
3267	NTIS (US Sales Only)	DE82750945	MN -80	8:7620
3270	NTIS (US Sales Only), PC A12/MF A01	DE82750693	MN -78	8:7621
3271	NTIS (US Sales Only), PC A07/MF A01	DE82750980	MN -38	8:8137
3276	NTIS (US Sales Only), PC A07/MF A01	DE82750739	MN -80	8:7630
3279	NTIS (US Sales Only), PC A05/MF A01	DE82750981	MN -78	8:7474
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3285	NTIS (US Sales Only), PC A04/MF A01	DE82750962	MN -11	8:8292
3288	NTIS (US Sales Only), PC A07/MF A01	DE82750692	MN -78	8:7631
3293	NTIS (US Sales Only), PC A03/MF A01	DE82750742	MN -80	8:7632
3304	NTIS (US Sales Only), PC A03/MF A01	DE82750703	MN -34C	8:8607
3310	NTIS (US Sales Only), PC A03/MF A01	DE82750663	MN -22	8:6988
3313	NTIS (US Sales Only), PC A04/MF A01	DE82750976	MN -20d	8:7910
3314	NTIS (US Sales Only), PC A04/MF A01	DE82750738	MN -4	8:7008
3319	NTIS (US Sales Only), PC A04/MF A01	DE82751055	MN -79	8:7633
3320	NTIS (US Sales Only), PC A07/MF A01	DE82750975	MN -79p	8:7634
3324	NTIS (US Sales Only), PC A04/MF A01	DE82750991	MN -38	8:8138
3333	NTIS (US Sales Only), PC A04/MF A01	DE82750988	MN -32	8:8894
3336	NTIS (US Sales Only), PC A02/MF A01	DE82750989	MN -22	8:6989
3358	NTIS (US Sales Only), PC A03/MF A01	DE82751053	MN -78	8:7635
3359	NTIS (US Sales Only), PC A03/MF A01	DE82751054	MN -78	8:7636
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003	NTIS (US Sales Only), PC A04/MF A01	DE82780794	MN -51	8:6983
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216	NTIS (US Sales Only), PC A09/MF A01	DE83900597	MN -38	8:7839
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1245	NTIS, PC A02/MF A01	DE83002542	MN -21	8:8865
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9373-PR	NTIS, PC A04/MF A01	DE83002917	STD -15	8:7072
9397-MS	NTIS, PC A04/MF A01	DE83002918	STD -70	8:7009
9415-C	NTIS, PC A14/MF A01	DE83001933	STD -45	8:8250
9464-MS	NTIS, PC A03/MF A01	DE83002914	STD -10	8:6996
9517-PR	NTIS, PC A02/MF A01	DE83002915	STD -79b	8:7490
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9555-MS	NTIS, PC A02/MF A01	DE83002951	STD -04	8:6993
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82-1664	NTIS, PC A02/MF A01	DE83000351	MN -78	8:7637
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82-1768	NTIS, PC A02/MF A01	DE82018431	MN -78	8:7645
82-1769	NTIS, PC A02/MF A01	DE82016281	MN -78	8:7646
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82-1787	NTIS, PC A02/MF A01	DE82017332	MN -78	8:7648
82-1800	NTIS, PC A02/MF A01	DE82017329	MN -78	8:7649
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82-1928	NTIS, PC A02/MF A01	DE82019572	MN -78	8:7652
82-2167	NTIS, PC A02/MF A01	DE82019532	MN -11	8:8468
82-3063	NTIS, PC A02/MF A01	DE83001973	MN -25	8:7010
82-3170	NTIS MF A01	DE83001982	MN -34D	8:8775
82-3466	NTIS, PC A02/MF A01	DE83003549	MN -34C	8:8657
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82/ 06	*See* DESY-82-017	DE82750712	MN -34D	8:8532
82/ 08	*See* DESY-82-020	DE82750715	MN -34D	8:8535
LBL-				
14317	NTIS, PC A02/MF A01	DE83002329	MN -20a	8:8866
14414	NTIS, PC A02/MF A01	DE83003051	MN -37	8:8229
14552	NTIS, PC A02/MF A01	DE83002328	MN -34	8:8502
14556	NTIS, PC A02/MF A01	DE83001568	MN -25	8:7913
14631	NTIS, PC A02/MF A01	DE83002233	MN -20a	8:8867
14708	NTIS, PC A02/MF A01	DE83001895	MN -4	8:8095
14722	NTIS, PC A02/MF A01	DE83003278	MN -70	8:7011
14774	NTIS, PC A10/MF A01	DE83003395	MN -34A	8:7914
14784	NTIS, PC A03/MF A01	DE83003635	MN -95d	8:7795
14797	NTIS, PC A02/MF A01	DE83001551	MN -25	8:7971
14914	NTIS, PC A03/MF A01	DE83003277	MN -95d	8:7796
14917	NTIS, PC A07/MF A01	DE83004118	MN -34A	8:8503
15062	NTIS, PC A03/MF A01	DE83002229	MN -11	8:8293
15063	NTIS, PC A02/MF A01	DE83003275	MN -63e	8:7121
15092	NTIS, PC A09/MF A01	DE83003757	MN -34	8:8504
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81-11	NTIS (US Sales Only), PC A02/MF A01	DE82703399	MN -32	8:8895
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1003/ 1-105/ (1982)	NTIS (US Sales Only), PC A06/MF A01	DE82702901	MN -4	8:8064
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82-027	NTIS, PC A12/MF A01	DE83002467	MN -62	8:7154
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254	*See* MIT-EL-82-037	DE83002477	MN -51	8:6987
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2948	NTIS, PC A04/MF A01	DE82020609	STD -4	8:8065
3015(OP)	NTIS MF A01	DE83001534	MN -25	8:8066
3022(OP)	NTIS, PC A02/MF A01	DE83001758	MN -25	8:7972
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86-61-0002	*See* DOE/DP-0053-1125	DE83003369	MN -92a	8:6964
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175	NTIS (US Sales Only), PC A05/MF A01	DE82750974	MN -34A	8:8505
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104	NTIS (US Sales Only), PC A02/MF A01	DE82751064	MN -37	8:8230
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44	NTIS (US Sales Only), PC A07/MF A01	DE82750413	MN -22	8:6990
45	NTIS (US Sales Only), PC A05/MF A01	DE82750434	MN -34	8:8128
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2750311	NTIS (US Sales Only), PC A02/MF A01	DE82750311	MN -92b	8:6941
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2750314	NTIS (US Sales Only), PC A05/MF A01	DE82750314	MN -95d	8:6961
2750317	NTIS (US Sales Only), PC A04/MF A01	DE82750317	MN -97e	8:7095
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2750321	NTIS (US Sales Only), PC A02/MF A01	DE82750321	MN -59c	8:7181
2750325	NTIS (US Sales Only), PC A07/MF A01	DE82750325	MN -94b	8:7246
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2750331	NTIS (US Sales Only), PC A02/MF A01	DE82750331	MN -95	8:7840
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2901259	NTIS (US Sales Only), PC A06/MF A01	DE82901259	MN -13	8:7696
2901931	NTIS (US Sales Only), PC A04/MF A01	DE82901931	MN -58c	8:7168
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2906252	NTIS (US Sales Only), PC A06/MF A01	DE82906252	MN -90i	8:6850
2906253	NTIS (US Sales Only), PC A07/MF A01	DE82906253	MN -90c	8:6723
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3900070	NTIS (US Sales Only), PC A22/MF A01	DE83900070	MN -4	8:7871
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3900242	NTIS (US Sales Only), PC A05/MF A01	DE83900242	MN -25	8:7915
3900243	NTIS (US Sales Only), PC A07/MF A01	DE83900243	MN -4	8:7891
3900244	NTIS (US Sales Only), PC A03/MF A01	DE83900244	MN -97d	8:7747
3900245	NTIS (US Sales Only), PC A10/MF A01	DE83900245	MN -13	8:7748
3900246	NTIS (US Sales Only), PC A08/MF A01	DE83900246	MN -11	8:8887
3900247	NTIS (US Sales Only), PC A06/MF A01	DE83900247	MN -25	8:7973
3900249	NTIS (US Sales Only), PC A04/MF A01	DE83900249	MN -60	8:7224
3900250	NTIS (US Sales Only), PC A05/MF A01	DE83900250	MN -25	8:7974
3900251	NTIS (US Sales Only), PC A09/MF A01	DE83900251	MN -25	8:7975
3900252	NTIS (US Sales Only), PC A02/MF A01	DE83900252	MN -13	8:7707
3900253	NTIS (US Sales Only), PC A02/MF A01	DE83900253	MN -13	8:7701
3900291	Information Services Center, Dept. of Natural Resources, Box 30028, Lansing, MI 48909		MN -92	8:7738
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3900305	NTIS (US Sales Only), PC A08/MF A01	DE83900305	MN -94b	8:7887
3900334	NTIS (US Sales Only), PC A09/MF A01	DE83900334	MN -96	8:7882
3900335	NTIS (US Sales Only), PC A10/MF A01	DE83900335	MN -90d	8:6725
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4893	NTIS, PC A02/MF A01	DE83002294	STD -21	8:8842
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70	NTIS, PC A06/MF A01	DE83002794	MN -4	8:8102
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0899	NTIS, PC A03/MF A01 - GPO $5.00	DE82905462	MN -80	8:7653
0914	NTIS- GPO $6.00	DE83900480	MN -41	8:8408
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2378	NTIS, PC A14/MF A01 - GPO $10.00	DE83002231	MN -80	8:7462
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81-14	New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223		MN -66b	8:7196
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HT	Haiti
HU	Hungary
HV	Upper Volta
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IB	International Bank for Reconstruction and Development
ID	Indonesia
IE	Ireland
IG	Inter-Governmental Maritime Consultative Organization
II	International Commission on Radiation Units and Measurements
IL	Israel

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IO International Labor Organization
IP International Union of Pure and Applied Physics
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TD Chad
TG Togo
TH Thailand
TN Tunisia
TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UE United Nations Educational, Scientific and Cultural Organization
UF United Nations Children's Fund
UG Uganda
UI United Nations Industrial Development Organization
US United States of America (USA)
UY Uruguay

VA Holy See
VD Democratic Republic of Viet-Nam
VE Venezuela
VS Republic of Viet-Nam

WM World Meteorological Organization
WS Western Samoa

XA International Atomic Energy Agency (IAEA)
XC European Organization for Nuclear Research (CERN)
XE Commission of the European Communities (CEC)
XF Food and Agriculture Organization of the United Nations (FAO)
XJ Joint Institute for Nuclear Research (JINR)
XM Council for Mutual Economic Assistance (CMEA)
XN Nuclear Energy Agency of the OECD (NEA)
XO Organization of African Unity (OAU)
XR International Commission on Radiological Protection (ICRP)
XS International Organization for Standardization (ISO)
XU United Nations (UN)
XW World Health Organization (WHO)
XX World Energy Conference (WEC)

YD Democratic Yemen
YE Yemen
YU Yugoslavia

ZA South Africa
ZM Zambia
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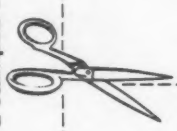

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